125-136

Vol. 2.

TRANSCRIPT OF RECORD.

SUPREME COURT OF THE UNITED STATES.

OCTOBER TERM, 1886.

No. 883. 537

RICHARD A. TILGHMAN, APPELLANT,

vs.

WILLIAM PROCTOR, JAMES GAMBLE, W. A. PROCTOR, JAMES N. GAMBLE, AND GEORGE H. PROCTOR.

FILED APRIL 17, 1886.

No. 895. 548

WILLIAM PROCTOR, JAMES GAMBLE, W. A. PROCTOR, JAMES N. GAMBLE, AND GEORGE H. PROCTOR, APPELLANTS,

vs.

RICHARD A. TILGHMAN.

FILED MAY 3, 1886.

APPEALS FROM THE CIRCUIT COURT OF THE UNITED STATES FOR THE SOUTHERN DISTRICT OF OHIO.

Vol. 2.

SUPREME COURT OF THE UNITED STATES.

OCTOBER TERM, 1886.

No. 883.

RICHARD A. TILGHMAN, APPELLANT,

vs.

WILLIAM PROCTOR, JAMES GAMBLE, W. A. PROCTOR, JAMES N. GAMBLE, AND GEORGE H. PROCTOR.

FILED APRIL 17, 1886.

No. 895.

WILLIAM PROCTOR, JAMES GAMBLE, W. A. PROCTOR, JAMES N. GAMBLE, AND GEORGE H. PROCTOR, APPELLANTS,

vs.

RICHARD A. TILGHMAN.

FILED MAY 3, 1886.

APPEALS FROM THE CIRCUIT COURT OF THE UNITED STATES FOR THE SOUTHERN DISTRICT OF OHIO.

JUDD & DETWEILER, PRINTERS, WASHINGTON.

	Original.	Print.
Mandate of Supreme Court U. S.	1106	1193
Motion for leave to file amended answer	1110	1194
Decree on mandate and order of reference	1111	1194
Order overruling motion for leave to file amended answer	1113	1195
Issuance of order of reference	1114	1195
Oath of special master	1114	1196
Report of special master	1116	1196
Table A—License fees and interest	1127	1204
B—Glycerine water	1129	1206
Testimony, exhibits, &c., accompanying report of special master	1130	1206
Testimony of James N. Gamble	1132	1208
James Gamble	1146	1216
Wm. A. Proctor	1149	1219
James W. Donnelly	1169	1231
James N. Gamble (recalled)	1171	1233
Robert Shoemaker	1176	1236
Richard A. Tilghman	1184	1241
Charles Bullock	1188	1244
Complainant's Exhibit—Bullock & Crenshaw Purchase Book	1191	1245
Testimony of Benjamin C. Tilghman	1192	1246
James N. Gamble (recalled)	1197	1249
Herman Endemann	1199	1250
John W. Hill	1273	1295
John H. Manning	1327	1327
Wm. A. Proctor	1333	1331
Wm. L. Dudley	1339	1334
James N. Gamble	1350	1334
John M. Donnelly	1372	1372
John A. Pentland	1375	1354
Henry Morton	1376	1355
Herman Endemann (recalled	1429	1386
Henry Morton (resumed)	1432	1388
James N. Gamble	1494	1424
Henry Morton (recalled)	1504	1430
James N. Gamble (recalled)	1564	1466
Gustave Janssen	1564	1466
Edmond Baujard	1576	1474
Exhibits offered	1583	1477
Testimony of Henry Bower	1585	1478
Washington Jones	1591	1481
John J. Emery	1600	1487
Complainant's Exhibits—		
No. 1—Sulphuric acid statement	1622	1501
No. 2—Glycerine statement	1628	1507
No. 3—Amount and value of stock saponified May 1, 1870 to January 9, 1875	1629	1508
No. 4—Lime statement	1631	1512
No. 5—Collier & Werk guaranty	1632	1513
No. 6—Article from The American Journal of Pharmacy, Vol. 51, pp. 289–291, entitled Glycerine—Its early manufacture in this country. By Rob't Shoemaker	1634	1514

	Original.	Print.
Complainant's Exhibits—		
No. 7—Bullock & Crenshaw Purchase Book (not set out, see p. 1191)	1637	1516
No. 8—Wilson's lecture on a new process of obtaining and purifying glycerine	1638	1516
No. 9—Extract from letter of Ascagne Sobrero to M. Pelouze, upon several detonating compounds produced with nitric acid and sugar, dextrine, lactine, mannite, and glycerine	1645	1521
Defendant's Exhibits—		
No. 1—Article from Dingler's Polytechnic Journal, Vol. 214, p. 56. On quantity of neutral fat contained in fatty acid mixtures, &c. By K. Birnbaum	1648	1522
No. 2—Wagner's Year Book, 1863. P. 665. Berthelot	1651	1524
No. 3—Wagner's Year Book, 1864. P. 630	1652	1525
No. 4—Fownes, 1868. P. 663	1652	1525
No. 5—Allen, Vol. 2, p. 120	1653	1525
No. 6—Musprat, 1877. Vol. 4, p. 458	1653	1525
No. 7—Article from Erdmann's Journal of Practical Chemistry. On action of sulphuric acid on oils. By Edmond Fremy	1653	1525
No. 8—Liebig & Kopp Year Book, 1853. P. 452. Berthelot	1654	1526
No. 9—Article on Fat Industry and Glycerine. By Kraut	1655	1526
No. 10—Article on Fat Industry and Glycerine. By Kraut	1655	1527
No. 11—Musprat's Handbook of Technology (German Edition), 1877. Vol. 4. p. 455	1656	1527
No. 12—Extract from Wagner's Year Books on uses of Glycerine	1656	1527
No. 13—Table of Pressures and Temperatures	1661	1530
No. 14—Table of Analyses	1662	1531
No. 15— " at 225 pounds	1663	1532
No. 16—Table of Glycerine Water Densities at 225 pounds	1663	1533
No. 17—Gamble Letters	1664	1533
No. 18—Extract from Encyclopædia of Chemistry. By James C. Booth. Philadelphia, 1850. P. 889	1666	1534
No. 19—Article from Dingler's Polytechnic Journal, 1881. Vol. 240, p. 62. On the determination of undecomposed fat in mixtures used for the preparation of fatty acids. By Dr. Oskar Hausamann	1666	1534
No. 20—Groger Article No. 1, from Dingler's Polytechnic Journal, 1882. Vol. 244, p. 303	1671	1537
No. 21—Groger Article No. 2, from Dingler's Polytechnic Journal, 1882. Vol. 246, p. 286	1682	1543
No. 22—Contribution to the Analysis of Fats. By Karl Zulkowski	1686	1546
No. 23—Cooley Article, from Cooley's Cyclopædia of Practical Receipts. Sixth Edition, 1880. Pp. 1556–1558	1688	1547
No. 24—Payen. German Edition, 1874	1693	1550
No. 25—Letters Patent No. 301, granted Wilson & Payne, February 8, 1885	1694	1550
No. 26—Diagram of Tilghman Coil No. 1	1699	1553
No. 27— " " No. 2	1700	1553
No. 28— " " No. 3	1701	1553

	Original.	Print.
Context of Defendant's Exhibit—		
No. 2—Wagner's Year Book, 1863. P. 664	1702	1553
Complainant's Exhibit—		
No. 10—Report of Juries of London Exhibition of 1851. On soap	1703	1554
Defendant's Exhibits—		
No. 29—Diagram of distilling apparatus	1704	1554
No. 30—Diagram of laboratory digester	1705	1554
No. 31—Drawing from appellant's brief	1706	1554
Complainant's Exhibits—		
No. 21—Diagram of Perkin's joint	1707	1554
No. 11—Morfit on Soap and Candles	1708	1554
No. 12—Ure's Dictionary of Arts. Boston, 1883. Vol. 2, p. 673. Title, soap	1710	1555
No. 13—Roret's Encyclopædia on Stearic candles. Paris, 1849. P. 112	1711	1556
No. 14—Muspratt's Chemistry, 2d Vol., p. 879. Title, soap	1713	1557
No. 15—Roret's Encyclopædia on Stearic candles. Paris, 1849. P. 109–114	1714	1557
No. 16—Muspratt's Chemistry, Vol. 1, p. 430	1715	1558
No. 17—Morfit on Soap and Candles. Philadelphia, 1847. P. 430	1715	1558
No. 18—Pelouze & Fremy's Chemistry, Vol. 5, p. 948	1715	1559
No. 19—Mohr, Redwood & Proctor's Pharmacy. Philadelphia, 1849. P. 488	1716	1559
No. 20—Pelouze & Fremy's Chemistry. Paris, 1865. Vol. 5, p. 951	1716	1559
No. 24—Table showing specific gravity of glycerine solutions. Wagner's Year Book, 1880. P. 442	1718	1560
Drawing from appellant's brief referred to witness Morton	1719	1560
Complainant's Exhibits—		
No. 22—Drawing of defendant's still	1720	1560
No. 23—Drawings of digester apparatus	1721	1560
Exceptions of complainant to master's report	1722	1561
defendants "	1729	1563
Final decree	1736	1566
Order allowing appeal of Tilghman	1737	1566
Appeal bond of Tilghman	1738	1566
Citation to Proctor *et al.*	1743	1568
Proof of service of citation	1744	1568
Clerk's certificate	1745	1569
Order allowing appeal of Proctor *et al.*	1747	1570
Appeal bond of Proctor *et al.*	1748	1570
Waiver of citation on appeal of Proctor *et al.*	1750	1571
Clerk's certificate	1751	1571

1105–1106 And afterward, to wit, on the 27th day of July, in the year of our Lord one thousand eight hundred and eighty-one, a mandate from the Supreme Court of the United States was received and filed in this cause in the clerk's office of the Court aforesaid; which said mandate was also duly entered upon the journal of the said Court, which said entry is clothed in the words and figures following, to wit:

Mandate of Journal "U," page 146.

RICHARD A. TILGHMAN *vs.* WILLIAM PROCTOR, JAMES GAMBLE, W. A. PROCTOR, JAMES N. GAMBLE, and GEORGE H. PROCTOR.	No. 1877. Equity.

Now come the solicitors for the complainant and present to the court the mandate from the Supreme Court in this case, which is ordered to be spread upon the minutes of this court, and is accordingly done as follows:

UNITED STATES OF AMERICA, *ss:*

The President of the United States of America to the honorable the judges of the circuit court of the United States for the southern district of Ohio, Greeting:

1107 Whereas lately, in the circuit court of the United States for the southern district of Ohio, before you or some of you, in a cause between Richard A. Tilghman, complainant, and William Proctor, James Gamble, W. A. Proctor, James N. Gamble, and George H. Proctor, defendants, wherein the decree of the said circuit court entered in said cause on the 2nd day of December, A. D. 1874, is in the following words, viz:

"This cause came on for hearing upon the bill of complaint, the joint and several answers of defendants, the several stipulations filed by counsel for the respective parties, and the printed record of the Supreme Court of the United States in the case of Roland G. Mitchell *vs.* the said Richard A. Tilghman, by agreement of counsel put in evidence in this cause, and was argued by counsel and submitted; and thereupon on consideration thereof the court find the equity of the case to be with the defendants. It is therefore ordered, adjudged, and decreed by the court — the bill of complaint herein filed be, and the same is hereby, dismissed at the costs of said complainant,

1108 taxed at $83.10, to be paid within ten days from the date of the entry hereof, in default of which execution is therefor awarded as upon judgments at law," as by the inspection of the transcript of the record of the said circuit court, which was brought into the Supreme Court of the United States by virtue of an appeal, agreeably to the act of Congress in such cases made and provided, fully and at large appears; and whereas in the present term of October, in the year of our Lord one thousand eight hundred and eighty, the said cause came on to be heard before the said Supreme Court on the said transcript of record and was argued by counsel: On consideration

whereof it is now here ordered, adjudged, and decreed by this court that the decree of the said circuit court in this cause be, and the same is hereby, reversed with costs, and that the said complainant, Richard Tilghman, recover against the said defendants nine hundred and eighty-eight dollars and seventy-two cents for his costs herein expended, and have execution therefor.

And it is further ordered that this cause be, and the same
1109 is hereby, remanded to the said circuit court with directions to proceed in conformity with the views of the Court as they will be expressed in the opinion to be filed 24th January, 1881.

You, therefore, are hereby commanded that such execution and further proceedings be had in said cause in conformity with the opinion and decree of this Court, as according to right and justice and the laws of the United States ought to be had, the said appeal notwithstanding.

Witness the Honorable Morrison R. Waite, Chief Justice of said Supreme Court, the third day of May, in the year of our Lord one thousand eight hundred and eighty-one.

And afterward, to wit, on the 8th day of February, A. D. 1882, came the said respondents by their solicitor aforesaid, and filed in the clerk's office of the Court aforesaid in this cause their certain motion for leave to file an amendment to their answer, which motion is clothed in words and figures following, to wit:

1110 *Motion for Leave to File Am'd't to Answer.*

RICHARD A. TILGHMAN
against
WM. A. PROCTOR *et al.* } No. 1877.

Now come the defendants and move the Court for leave to file an amendment to the answer heretofore filed by them in this cause, setting forth that the alleged patent of the complainant had expired in January, 1868, and that the alleged extention thereof was void by reason of the fact that a patent had been issued in England in January, 1854, for said alleged invention, and that said American patent could not for said reason be the subject of an extension under the laws of the United States, but was limited thereby to a term of fourteen years from its date.

1111 And afterward, to wit, on the sixteenth day of February, in the year last aforesaid, an entry was made upon the journal of the Court aforesaid in this cause in words and figures following, to wit:

Decree and Order of Reference.

RICHARD TILGHMAN
vs.
WM. A. PROCTOR *et al.* } 1877. Equity.

This cause coming on for further hearing, in pursuance of the mandate of the Supreme Court of the United States, it is by the

Court this the 16th day of February, 1882, ordered, adjudged, and decreed that the patent issued to Richard A. Tilghman on the third day of October, 1854, and antedated as of the ninth day of January of that year, being letters patent No. 11766 for a process of manufacturing fat acids and glycerine from fatty bodies, is valid, and is a patent for a process, and is infringed by the defendants by the use of the process employed by them.

1112 It is further ordered, adjudged, and decreed that the complainant do recover from the said defendants whatever profit or saving has accrued to or been effected by them, by the use of the process covered by the said patent of the complainant, in accordance with the opinion of the Supreme Court herein, as well as any damages in excess thereof which the complainant has sustained by reason of the defendants' said infringement and which shall seem meet upon the coming in of the master's report.

It is further ordered, adjudged, and decreed that the complainant do recover of the defendants the costs and charges and disbursements in this suit to be taxed.

It is further ordered, adjudged, and decreed that it be referred to Channing Richards, Esq., as master, to ascertain and tax and state and report to the Court an account of the gains, profits, savings, and advantages which the said defendants have received or which have arisen or accrued to them from infringing the said exclusive rights of the said complainant by the use of the process patented

1113 in the said letters patent, as well as the damages the said complainant has sustained thereby.

And it is further ordered, adjudged, and decreed that the complainant, on such accounting, have the right to cause an examination of said defendants, *ore tenus* or otherwise, and also the production of the books, vouchers, and documents of defendants, and that the said defendants attend for such purpose before said master from time to time as said master shall direct.

And afterward, to wit, on the day and year last aforesaid, an entry was made upon the journal of the Court aforesaid in this cause clothed in the following words and figures, to wit:

Journal Entry U—291.

RICHARD TILGHMAN
vs.
WILLIAM PROCTOR *et al.* } 1877. Equity.

Motion overruled.

This cause came on to be heard upon the motion of respondents for leave to file an amendment to the answer heretofore filed

1114 herein, and was argued by counsel, and the Court being fully advised in the premises overrules the motion.

Issuing of Order of Reference.

And afterward, to wit, on the 17th day of February, in the year

last aforesaid, was issued out of the said the clerk's office of the court aforesaid in this cause to the said Channing Richards, Esq., so as aforesaid heretofore appointed special master herein, a certain certified copy of the said decree and order of reference, clothed in words and figures as hereinbefore set forth.

And afterward, to wit, on the day and year last aforesaid, came the said Channing Richards, Esq., special master herein as aforesaid, and took the oath prescribed by law as such said special master, and which said oath was filed in the said clerk's office of the court aforesaid, clothed in the words and figures following, to wit:

Oath of Special Master.

UNITED STATES OF AMERICA, *Southern District of Ohio,* } ss:

Channing Richards, heretofore appointed master in the
1115 case of R. A. Tilghman *vs.* Proctor *et al.*, No. 1877, circuit court S. D. O., being duly sworn, says that he will honestly and faithfully perform the duties of such master in accordance with the order of said court.

CHANNING RICHARDS.

Subscribed and sworn to before me this 17th day of February, 1882.

[L. S.] ROBT C. GEORGI,
Dep. Clerk U. S. Circuit Court S. D. O.

And afterward, to wit, on the eleventh day of August, in the year of our Lord one thousand eight hundred and eighty-four, came the said Channing Richards, Esq., special master herein as aforesaid, and submitted to the court, filing the same in the clerk's office of said court in this cause, his certain report of his findings of facts and of law upon the testimony taken by him under the said order of reference herein; which said report is clothed in the following words and and figures, to wit:

Report of Special Master Channing Richards, Esq.

1116 Circuit Court of the United States, Southern District of Ohio.
Equity.

RICHARD A. TILGHMAN, Complainant,
vs.
WILLIAM PROCTOR *et als.*, Respondents. } 1877.

To the honorable judges of the circuit court of the United States for the southern district of Ohio:

Channing Richards, the master appointed herein, respectfully reports unto your honors that since the order of reference a large mass of testimony has been taken by the parties, both in Cincinnati

and elsewhere, which is herewith submitted with accompanying exhibits.

This testimony, and also the evidence contained in the Supreme Court record, have been carefully considered by the master, who has been aided by able arguments both on behalf of complainant and respondents.

Complainant's Damages.

The master finds from the evidence that complainant has derived no profit from the invention involved in this suit otherwise than by granting licenses to others to use the same. These licenses have been granted to all manufacturers desiring to use his process
1117 at a substantially uniform fee of twenty cents for each hundred pounds of fat treated, payable monthly. For several years respondents held such a license from complainant, but terminated the same, refusing to pay the stipulated license fees after May 1st, 1870, although continuing to use the process until the expiration of the patent on the 8th day of January, 1875.

In such a case the established license fees, with interest thereon from the time when due, have been held by the Supreme Court to be the measure of damage to a patentee by infringement of his patent. (Seymour *v.* McCormick, 16 How., 488.) The accompanying table, A, shows the quantity of fat treated by respondents during each month of infringement, the license fees therefor, and interest thereon to October 7th, the first day of the October term, 1844, making the total amount of complainant's damages herein $79,566.71.

Respondents' Gains and Savings.

Complainant has not attempted to establish any other damage to himself from the infringement by respondents, but has endeavored to show that large gains, profits, savings, and advantages have accrued to respondents from use of the patented process. Respondents claim that, inasmuch as complainant had established license fees for the use of his patent, he is not entitled to recover the gains and profits accruing to them in excess thereof; but the order of reference herein requires the master to ascertain and report to the court an account of the gains, profits, savings, and advantages that have so accrued to them, as well as the damages sustained by complainant, and does not authorize him to determine which should be the measure of recovery in the case.

So, too, in reference to the question raised by respondents upon the testimony of B. C. Tilghman, a brother of complainant. (Master's Record, pp. 64, 66, 67.) It appears that he has had an interest in all recoveries and license fees under the patent, and had acquired an interest in any recovery that may be made in this suit before its commencement. Respondents, therefore, claim
1118 that complainant can recover herein no more than this own share, and, having failed to show the extent of his interest, is only entitled to nominal damages; but in view of the decree en-

tered in his favor the master does not deem that question to be involved in the reference.

Proceeding, in obedience to the order of reference, to ascertain the gains, profits, savings, and advantages which respondents have received, or which have arisen or accrued to them from the infringement of complainant's patent, the master finds from the evidence that at that time the lime-saponification process was more advantageous than any other then open to public use.

Saving in Chemicals.

By that process the neutral fat was converted into lime soap by boiling it in open tubs with lime. The water was then run off containing the glycerine, and the lime soap was treated with sulphuric acid, which combined with the lime, forming sulphate of lime, and released the fatty acid acids. Theoretically, 9½ lbs. of lime and double that quantity of sulphuric acid for each hundred pounds of fat treated were sufficient to effect these results; but, in practical operation, manufacturers used from 12 to 14 lbs. of lime per hundred, and from 2 to 3 lbs. of acid for each pound of lime to insure perfect decomposition.

Respondents, during the period of infringement, treated the fat with water in closed digesters, adding one per cent. of lime, and heating with steam at a pressure of 225 lbs. for about nine and a half hours. Then they precipitated the lime by using 3 lbs. of sulphuric acid for each pound of lime. As compared with the average amount of each employed in the old process, they saved 12 lbs. of lime and 29½ lbs. of sulphuric acid for each hundred pounds of fat treated.

Their books show that they thus treated 23,322,777 lbs. of fat during the period in question, saving 2,798,733 lbs. of lime and 6,880,219 lbs. of sulphuric acid upon the basis above mentioned. The
1119 testimony shows the average cost of lime to have been $.3526 per hundred pounds, and the average cost of the acid $2.527 per hundred.

Respondents thus saved:

2,798,733 lbs. of lime, at $.3536 per hundred	$9,868 33
6,880,219 lbs. of acid, at $2.527 per hundred	173,863 13
Total saving in chemicals	$182,731 46

Economy of Operation.

It is claimed that the evidence shows a loss of fatty acids by entanglement with the sulphate of lime in the old lime-saponification process, most of which was saved by the process employed by respondents.

There is necessarily some loss of materials in every process of manufacture—more in some than others—but the amount cannot always be determined by general rules, as it frequently depends upon

the condition of apparatus and the exercise of care in the operation. The testimony upon which complainant relies to establish this claim is contained in the Supreme Court record. It has no special relation to the operations at respondents' factory, but consists either of general statements, partaking somewhat of conjecture, or relates to the operations of other factories, while the testimony taken by complainant before the master, which does relate to operations conducted by respondents, fails to show any appreciable difference in the amount of fatty acids obtained by them under each process, special precautions having been taken to reduce as far as possible the loss by entanglement. Upon this evidence the master is unable to determine what saving has been effected by respondents in this particular. So in reference to the cost of manufacture. Considering the relative cost and wear of apparatus, as well as the difference in labor and fuel required, the master finds no material economy in operation secured by the change of process.

1120 *Value of Glycerine Water.*

It appears from the evidence that the average density of glycerine water obtained in the old lime-saponification process was only ¾° Baume, while that obtained from the digesters was from 3° to 3¼°. It also appears that the concentration of the latter to 15° cost $1.55 per barrel at respondents' factory.

Assuming the cost of concentration to be in like proportion for each degree, it is claimed that concentration from ¾° to 3¼° would cost nearly $.94 per barrel, and the cost of such concentration is an item of gain and saving realized by respondents by reason of the greater density of the glycerine water obtained from the digesters, for which they should be charged in this accounting. But there is no testimony establishing that the cost of concentration is in proportion to its degree, nor is it reasonable to assume such to be the fact; indeed it is apparent that the cost of concentrating a single degree would be much greater in proportion than a more extensive operation, while an additional degree of concentration in an extensive operation would affect the cost but little.

It appears in evidence that glycerine water was sold in the market at so much per barrel for each degree of density, and that respondents sold it at the market price as it came from the digesters. It, however, required considerable concentration to prepare it for use, and they boiled it down to 15° for the purchasers, charging the cost thereof to them. Provided as they were with facilities for such work, the additional cost of concentration from a still lower degree could not be great. The only witness whose testimony is directly in point says it would not be material (Supreme Court record, 930). Besides, if paid by the purchaser, it would not affect the profits of respondents.

But the evidence does show a larger yield of glycerine by the new process. While the old lime-saponification process was in use glycerine had no market value; consequently no effort was made to secure it, and there is no direct testimony as to the best results that

1121 could be secured by careful treatment, but the testimony shows that the average density of the glycerine which ran to waste was $\frac{3}{4}°$, and that it was about equal in volume to the fat.

It is claimed that the same volume of glycerine water was drawn from the digesters while its density was much greater. But the master finds from the evidence that respondents used two charges of water, each half the bulk of the fat, the first charge drawn from the digesters being the glycerine water sold by them. There was, consequently, double the volume of glycerine water in the former process, which accounts, in part, for difference in density; but the comparison still shows considerable loss due to various causes, which is further increased by the additional concentration required, the average result of tests made in various degrees of concentration indicating that it requires about $4\frac{1}{5}$ bbls. of $\frac{3}{4}°$ to make one of 3°.

The accompanying table, B, shows the quantity and value of glycerine water obtained by respondents from the digesters and also the number of bbls. concentrated to 3° that could be obtained from the fat treated by lime saponification, and the value thereof at market prices, the difference being the amount gained by reason of the greater yield of glycerine from the digesters, viz., $61,701.77.

Loss of Fatty Acids.

The quality and value of the fatty acids obtained by respondents through the patented process is likewise involved in this accounting. If, like the glycerine water, they were more valuable than could have been obtained by the old process the profits realized therefrom must also be charged to respondents, or, if less valuable, the loss must be taken into consideration in determining the net gain which has accrued to them from the new process.

It appears from the evidence that the value of fatty acids for manufacture into candles depends largely upon their purity, and the practical value of any process of saponification depends mainly upon completeness of result. If the fats are not entirely decom-

1122 posed there is a corresponding loss of fatty acids, which is the valuable product sought, and, moreover, the admixture of undecomposed fat seriously affects the value of the product obtained.

The quality and value of the stock produced by complainant's process in various forms of operation has been the chief question in controversy before the master, and much testimony has been taken in relation thereto.

Respondents cannot be charged with any advantages they might have realized by use of that process otherwise than as they in fact used it.

Livingston *v.* Woodworth, 15 How., 559.
Dean *v.* Mason, 20 How., 203.

This question cannot, therefore, be determined by reference to results secured by use of the coil apparatus described in complainant's patent. If, as claimed by him, that is the best mode of applying the process, respondents cannot be charged with its advantages, for they did not use it. Nor is their liability affected by its defects,

if, as claimed by them, its use is wholly impracticable. Neither is it material in this case whether the Wright & Fouché apparatus used by Mitchell & Co. had yielded a superior product.

In the absence of more direct testimony the result of operations in those forms of apparatus might afford some aid in determining results otherwise obtained by respondents, but evidence more nearly in point renders such resort unnecessary.

They used digesters provided with a pumping device designed to maintain the mixture of fat and water. This apparatus has been held by the Supreme Court in this case to be a convenient vessel for the operation of the patented process—"the manufacturing of fat acids and glycerine from fatty bodies by the action of water at a high temperature and pressure." These digesters were originally erected for them by complainant, and were similar to those used by other licensers.

It does not appear that saponification by water alone in such
1123 digesters has been regularly employed by any one, but the testimony shows that several persons operating under licenses from complainant tried to do so without success. In some instances they tried the experiment under supervision of complainant or his agent. They all became satisfied that a satisfactory result could not be secured by that process alone, and found it necessary to employ some additional agency to secure complete saponification at safe pressures within reasonable time.

Complainant, though stoutly maintaining the advantages of his process, could not induce manufacturers to adopt it without important modifications. It was, however, found that by using a small percentage of lime satisfactory results could be secured at moderate pressures, which modification was acquiesced in by complainant, and in some instances recommended by him. It was also found that a change of water during the operation was an advantage, and in 1860 complainant himself obtained a patent therefor.

During the period of this accounting respondents used one per cent. of lime and a second charge of water, completing the process in about nine and a half hours, at a pressure of about 225 lbs. With these two modifications, both of which are shown by the evidence to be efficient, a good quality of fatty acids was obtained, though not fully equal to that obtained by lime saponification.

Whatever advantages accrued to respondents from these modifications are not involved in this suit. (Mason *v.* Graham, 23 Wal., 276.)

They can only be called upon to account for the gains, profits, savings, and advantages secured by the action of water in the operation. Manifestly the saving of chemicals and increased value of glycerine water would not render the process valuable to them if the fatty acids, which were the chief product sought, were unfit for use, and, so far as those acids were less valuable than could be secured by the old process, the gains and advantages otherwise secured would be diminished.

As already stated, several manufacturers endeavored to de-
1124 compose fat in digesters by water alone, under supervision of complainant or his agent, who were interested in securing the best results. The testimony in relation to these unsuccessful experiments is contained in the Supreme Court record. N. Ropes, Sr., (pages 504 and 377) says that it required twenty hours to produce good stock without lime or change of water; and, although there was considerable saving of expense, he was not prepared to say that it would be more profitable than lime saponification. N. Ropes, Jr., his son and partner (page 500), says he was not satisfied that the process without lime could be profitably used. C. H. Grant (page 372) says that the fatty acids required additional treatment, and the process was less profitable than the old processes. Ropes & Co. continued to use the process with lime and change of water, but Grant abandoned it after two years, adopting sulphuric acid distillation. All these experiments, however, were made at a pressure of 150 or 160 lbs. C. T. Jones (page 33) obtained satisfactory products, without lime, at a pressure of 300 lbs., but found it more profitable to use lime, reducing the pressure to 250 lbs., and saving fuel, labor, and time. Wm. Cornwall (page 920), at from 240 to 250 lbs. pressure, found the results not satisfactory without lime, the quality of the fatty acids not being as good.

This testimony is uncontradicted; indeed it is corroborated by all the evidence in point; and the master finds that the fatty acid product obtained by respondents, operating in their digesters for nine and a half hours, at an average pressure of 225 lbs., by the action of water alone, was inferior in value to the product of lime saponification.

The experiments made pending the hearing before the master at 225 lbs. pressure, without lime or change of water, yielded products containing an average of 92.5 per cent. of fatty acids (Defendants' Exhibit No. 15), while various experiments at lower pressures (Defendants' Exhibit No. 14) showed products still more inferior.

As compared with the result of lime saponification the experiments at 225 lbs. pressure show a loss of 6 lbs. of free fatty acids for each hundred pounds of fat treated, and an admixture of un-
1125 decomposed fat seriously affecting the value of the product. There is no direct testimony as to the value of the fatty acids; but considering the cost of fat (Complainant's Exhibit No. 3) and the cost of manufacture, as shown by the evidence, the master finds that they were worth at least 9 cents per pound, making the direct loss of fatty acids not less than 54 cents upon each hundred pounds of fat treated.

There is no testimony from which the master can determine to what extent the value of fatty acids actually obtained was affected by the admixture of undecomposed fat and no allowance has been made therefor.

During the period of infringement respondent treated 23,322,777 lbs. of fat in their digesters with one per cent. of lime. The evidence shows that 11½ lbs. of lime completely saponify 100 lbs. of fat, in close digesters, under pressure (Supreme Court record, 563), and the

master finds that in the process employed by respondents 2,028,024 lbs. of the fat treated by them were converted into lime soap by the action of lime, and 21,294,753 lbs. were converted into a fatty acid mixture containing 92.5 per cent. of free fatty acids by the action of water, the further decomposition of such mixture being effected by modifications of complainant's process.

Net Gains and Savings.

The following statement shows the net gain and saving which the master finds have accrued to respondent's from the use of complainant's process:

Amount saved in chemicals, as above found	$182,731 46
Amount gained on glycerine water	61,701 77
Total	$244,433 23
Deducting loss in fatty acids, being 54 cents per hundred on 21,294,753 lbs. of fat	$114,991 76
Net gains and savings	$129,441 47

Interest.

Applying the rule as to allowance of interest defined by the
1126 Supreme Court to the circumstances of this case the master finds that complainant is not entitled to interest upon the profits so found to have accrued to respondents.

Mowry *v.* Whitney, 14 Wal., 653.

Parks *v.* Booth, 102 U. S., 106.

Reduction of Values.

Assuming that the general introduction of complainant's process must have reduced the value of fatty acids, it is claimed on behalf of respondents that the gains and savings effected thereby have accrued to the public as consumers of candles, and not to themselves as manufactures. It is unnecessary to determine what would be the result if that fact were established by evidence; but there is no evidence on the subject, and the facts cannot be presumed. Nor was it incumbent upon complainant to show that such was not the fact.

Master's Report.

Upon the whole testimony the master finds, and so reports to the court:

1. That the gains, profits, savings, and advantages which respondents have received or which have arisen or accrued to them from infringing the exclusive rights of complainant by the use of the process patented in his letters patent amount to $129,441.47.

2. That the damages which complainant has sustained thereby amount to $79,566.91.

Respectfully submitted,

CHANNING RICHARDS, *Master.*

Cincinnati, July, 1884.

TABLE A.

License Fees and Interest.

Date.	Fat treated.	License—20c. per 100 lbs.	Interest to Oct. 1, 1884.				
1870.	*Lbs.*		*Yrs.*	*Mos.*	*Per ct.*	*Amount.*	
May	336,157	$672 31	14	4	.86	$578 18	
June	448,449	896 89	14	3	.855	766 84	
September	374,513	749 02	14	0	.84	629 17	
October	370,577	741 15	13	11	.835	618 86	
November	395,166	790 33	13	10	.83	655 97	
December	348,837	697 67	13	9	.825	575 57	
		$4,547 37				$3,824 59	$8,371 96
1871.							
January	303,575	607 15	13	8	.82	497 86	
February	428,940	857 88	13	7	.815	699 17	
March	411,424	822 84	13	6	.81	666 50	
April	368,211	736 42	13	5	.805	592 81	
May	349,684	699 36	13	4	.80	559 48	
June	389,140	778 28	13	3	.795	618 73	
July	146,731	293 46	13	2	.79	231 83	
August	192,263	384 52	13	1	.785	301 84	
September	296,567	593 13	13	0	.78	462 64	
October	350,149	700 29	12	11	.775	542 72	
November	515,637	1,031 27	12	10	.77	794 07	
December	390,113	780 22	12	9	.765	596 86	
		$8,284 82				$6,564 51	14,849 33
1872.							
January	339,841	679 68	12	8	.76	516 55	
February	306,975	613 95	12	7	.755	463 52	
March	441,813	883 62	12	6	.75	662 71	
April	442,375	884 75	12	5	.745	659 13	
May	379,242	758 48	12	4	.74	561 27	
June	267,163	534 32	12	3	.735	392 72	
July	70,517	141 03	12	2	.73	102 95	
August	502,345	1,004 69	12	1	.725	728 40	
September	403,790	807 58	12	0	.72	581 45	
October	570,015	1,140 03	11	11	.715	815 12	
November	522,929	1,045 85	11	10	.71	742 55	
December	637,086	1,274 17	11	9	.705	898 29	
		$9,768 15				$7,124 66	16,892 81
1873.							
January	527,314	1,054 62	11	8	.70	738 23	
February	578,068	1,156 12	11	7	.695	803 50	
March	503,288	1,006 57	11	6	.69	694 53	
1128 April	542,741	1,085 48	11	5	.685	743 55	
May	513,817	1,027 63	11	4	.68	698 78	
June	389,142	778 28	11	3	.675	525 33	
August	396,415	792 83	11	1	.665	527 23	
September	390,457	780 91	11	0	.66	515 40	
October	386,570	773 14	10	11	.655	506 40	
November	616,606	1,233 21	10	10	.65	801 58	
December	566,811	1,133 62	10	9	.645	731 18	
		10,822 41				$7,285 71	$18,108 12

TABLE A—Continued.

License Fees and Interest.

Date.	Fat treated.	License—20c. per 100 lbs.	Interest to Oct. 1, 1884.				
			Yrs.	*Mos.*	*Per ct.*	*Amount.*	
1874.	*Lbs.*						
January	624,262	1,248 52	10	8	.64	799 05	
February	504,845	1,009 69	10	7	.635	641 15	
March	577,894	1,155 78	10	6	.63	728 14	
April	594,736	1,189 47	10	5	.625	743 41	
May	639,151	1,278 30	10	4	.62	792 54	
June	414,523	829 04	10	3	.615	509 85	
August	285,076	570 15	10	1	.605	344 94	
September	669,763	1,339 52	10	0	.60	803 71	
October	856,689	1,713 37	9	11	.595	1,019 45	
November	605,662	1,211 32	9	10	.59	714 67	
December	564,413	1,128 82	9	9	.585	660 35	
		12,673 98				$7,757 26	20,431 24
1875.							
January	274,310	548 62	9	8	.58	318 19	318 19
License fees and interest to October 1, 1884							$79,520 27
Add interest to October 7, 1884, six days							46 64
Total to October term, 1884							$79,566 91

TABLE B.

Glycerine Water.

Year.	From digesters.				Market price per degree.	From lime saponification.			Gain by digesters.
	Bbls.	*Price.*	*Density.*	*Value.*		*Bbls. at 3°.*	*Bbls. at 2°.*	*Value.*	
1870 ..	8,041	93¼	3	$7,534 60	31¼	16,082	3,350	$3,140 62	$4,393 98
1871 ..	10,649	93½	3	9,983 39	31¼	21,298	4,437	4,159 68	
	1,039	87½	3¼	965 37	27	2,138	445	360 45	
	1,787	1.50	3	2,680 50	50	3,574	744	1,116 00	
	1,461	1.62½	3¼	2,374 12	50	2,922	608	912 00	
	14,966			$15,973 38		29,932	6,234	$6,548 13	9,425 25
1872 ..	13,702	1.62½	3¼	22,265 68	50	29,404	5,709	8,563 50	13,702 18
1873 ..	11 473	1.62½	3¼	18,643 61	50	22,946	4,780	7,170 00	
	982	1.78	3	1,156 92	39½	1,964	409	481 80	
	1,607	2.35½	3	3,786 31	78½	3,214	669	1,575 49	
	14,062			$23,586 84		28,124	5,858	$9,227 29	14,359 55
1874 ..	1,497	2.27	3¼	3,395 12	70	2,994	623	1,308 30	
	11,127	2.35½	3	26,217 44	78½	22,254	4,636	10,917 78	
	1,572	2.17½	3	3,419 60	72½	3,144	655	1,424 62	
	14,196			$33,032 16		28,392	5,914	13,650 70	19,381 46
1875 ..	345	2.17½	3	750 37	72½	690	143	311 02	439 35
Total .	65,312			103,143 03		134,624	27,208	41.441 26	$61,701 77

1130 And afterward, to wit, on the fourth day of September, in the year last aforesaid, there was filed in the clerk's office of the court aforesaid, in this cause, the report of testimony taken before the said Channing Richards, Esq., special master herein, under the said order of reference in this cause heretofore made, and which report of testimony, with exhibits accompanying the same, is in the words, figures, and drawings as follows, to wit:

Testimony, Exhibits, &c., Accompanying Report of Special Master.

FRIDAY, *February 17th*, 1882.

Channing Richards, having duly qualified as master in pursuance of the foregoing order of reference, proceeded to take the account therein specified, both parties being present by their solicitors.

Francis T. Chambers, Esq., for complainant; R. H. Parkinson, Esq., for respondents.

The solicitor for complainant calls upon the respondents for all

books, papers, and documents in their possession which relate to the nature, character, and extent of use of their process or processes for decomposing fats into fat acids and glycerine used by them since the end of April, 1870, until the 9th day of January, 1875,
1131 and especially for such books and papers as show the total quantity of fat so decomposed during the period inquired of, and the character and kind of fats used, the proportion or quantity of lime put into the digesters with the fat, and also the market price during each month of the tallow or other fats used, of the sulphuric acid, lime, and crude glycerine, and also such books and papers as show the quantity of crude glycerine sold by them.

The solicitor for respondents states that he has already, at the request of solicitor for complainant, instructed the respondents to make from their books a statement showing substantially the items called for, which statement is now in process of preparation and being proceeded with as rapidly as possible; that he believes it will, when finished, either dispense with the necessity for the production of the books and accounts called for, or will furnish a guide to the specific books and accounts which complainant may desire to have inspected by the master; that many of the books and accounts above recited are needed for frequent reference in the regular course of respondents' business, and it would be extremely inconvenient and, as he believes, unnecessarily detrimental to them to have such books removed from their office, and if there is occasion for their inspection he may desire to ask that it take place at their office.

And said solicitor further states that as soon as the above-mentioned statement is completed, or within a reasonable time thereafter, with reference to the convenience of the master and counsel, he will produce Mr. James N. Gamble, the party who is preparing it, for such examination as may be proper.

Adjourned, by consent, to Monday, March 20th, 1882. Subsequently changed, by consent, to Tuesday, March 21st.

1132 TUESDAY, *March 21st*, 1882.

Account resumed, both parties being present, by their solicitors, as before.

JAMES N. GAMBLE, one of the respondents, being duly sworn, produces the statements called for by complainant at the last meeting, including—

1. "Sulphuric Acid Statement." Showing sulphuric acid used from May 1st, 1870, to January 8th, inclusive—quantity and prices.

Same herewith filed as "Sulphuric Acid Statement."

Witness explains that this statement includes the whole amount of acid used in the establishment, a small portion of which was used otherwise than in the process inquired of, but there are no means of determining exactly the amount, which, however, was small.

2. "Glycerine Statement." Showing the glycerine produced dur-

ing the same period, giving quantity, price, and aggregate amount received for same.

Same herewith filed as "Glycerine Statement."

3. "Fat Statement." Showing amount and value of fat saponified during the same period, giving qualities, prices, aggregate quantity, and value, and average price.

Same herewith filed as "Fat Statement."

Witness states we are unable to give from our books the quantity of lime used, but I have a statement from J. B. Speed & Co., who supplied us for a portion of the time, showing the amount they delivered from September 11th, 1871, to October 20th, 1873, being 463 barrels (estimated average of 320 pounds each), costing 75 cents per barrel, amounting to $347.25.

1133 Examination of JAMES N. GAMBLE by F. T. CHAMBERS, solicitor for the complainant:

Q. 1. Did you personally prepare the statements given in evidence by you as to the amounts of fats and sulphuric acid used and glycerine produced?

A. No, I did not; but I have examined them and believe them to be correct. I have examined the glycerine statement particularly; the others I have not given any special examination to. I gave instructions to J. W. Donnelly, one of our clerks, as to what was required. He took the accounts from our books and handed them to me for examination.

Q. 2. Were the fats specified in the "fat statement" all manufactured into fatty acids and glycerine by the process described in your answer in this suit as the one used by you?

A. Yes, they were.

Q. 3. During the period included in your statement did your firm concentrate or refine any of the glycerine spoken of in the "glycerine statement," or was the crude glycerine sold as it came from the digesters?

A. We did not refine any. The crude glycerine was sold at the prices stated as it came from the digesters, but we did concentrate some of it for the purchasers at a special rate additional to the prices given in the statement.

Q. 4. Can you state about the strength of the crude glycerine as it came from the digesters?

A. I think about 3° Baumé, but will ascertain exactly from the books.

Q. 5. When you concentrated the glycerine for customers to what degree did you concentrate it, and what additional price was charged for so doing?

A. I will ascertain from the records.

Q. 6. When did you commence to use the process of decomposing fats mentioned in respondents' answer?

A. Some time in 1865, I think, but we did not use as much lime

then as the quantity named in the answer. We used about one-half per cent. at first.

1134 Q. 7. How did the process you used before 1865 differ from the one used since?

A. We then used a larger per cent. of lime and a lower degree of pressure on the digesters. I think we used 4 or 5 per cent. of lime. The process, I think, did not differ materially otherwise.

Q. 8. Please state how long you used that process and what process you used before its adoption.

A. I cannot say definitely, as I was not at the factory when the use of five per cent. of lime was introduced.

Q. 9. Please look at the testimony of James Gamble, on pages 515 and 516, Supreme Court record, and state who Mr. James Gamble was and whether the form then mentioned was the same as the respondents in this suit.

A. Mr. James Gamble is one of the senior partners of the firm of Proctor & Gamble, respondents in this suit.

Q. 10. Your firm was sued, was it not, by Mr. R. A. Tilghman for using the process which you used between 1858 and 1865, and under the same patent involved in this suit?

A. Yes; it was.

Q. 11. How was that suit terminated?

A. We agreed to pay Mr. Tilghman a sum of money for back royalties, and we took a license for the future under the patents.

Q. 12. The contract marked "Exhibit C" and printed on page 11 of the Supreme Court record was made between your firm and Mr. Tilghman at the time of that settlement, was it not?

A. Yes; it was.

Q. 13. Did Mr. Tilghman erect the apparatus for your firm which is spoken of in said contract?

A. Yes.

Q. 14. Did your firm pay Mr. Tilghman the royalties spoken of in the contract, and, if so, for how long a time? I refer you in that connection, also, to the contract, "Exhibit F," on page 12 of the Supreme Court record, which embraces the same terms as to royalties.

1135 A. We paid, under the first contract, to the expiration of the original patent, and under the second contract ("Exhibit F") until May 1st, 1870.

Q. 15. Since that date you have paid no royalty under Mr. Tilghman's patent?

A. No.

Q. 16. Why did you then cease to pay royalty?

A. We were advised by counsel that there was a probability of having the patent defeated, as it was subsequently; and we refused for that reason.

Q. 17. You were aware of the fact that there were at the time you declined to further recognize Mr. Tilghman's patent several suits pending between Mr. Tilghman and parties using substantially the same process you were using, were you not?

A. Yes; we were aware there were two suits pending at the time against Mr. Mitchell and Mr. Werk.

Q. 18. There had been decisions in both these cases in favor of the patent, had there not?

(Question objected to by solicitor for respondents as incompetent and irrelevant.)

A. I do not remember the state of the suits at the time. They were then going on, and no final decision had been reached—that is, in the suits mentioned above.

Q. 19. Was your firm informed of the nature and character of proceedings before the master to whom the suit of Tilghman *vs.* Mitchell was referred to state the accounts of the gains and savings made by the respondent through infringements of Mr. Tilghman's patent at the time you refused to further recognize the validity of of the patent?

A. I don't think we were.

Q. 20. Had you or your firm at that time, or prior thereto, been in correspondence or consultation with either Mr. Werk or Mr. Mitchell, or their counsel, with respect to the validity of Mr. Tilghman's patent and the propriety of your firm paying any further royalty under it?

(Question objected to as above.)

1136 A. Mr. Collier was Mr. Werk's counsel at the time, and we consulted with him. He advised us that we ought not further to pay. There had been correspondence with Mr. Mitchell and other candle manufacturers on the subject of Mr. Tilghman's patent prior thereto.

Q. 21. Was it in consequence of Mr. Collier's advice to you that you declined to further recognize the patent and employed him as your counsel?

(Question objected to as above.)

A. Yes.

Q. 22. Had you any other reason for your action except Mr. Collier's advice?

(Question objected to as above.)

A. We did not want to pay any more money for it.

Q. 23. Any other reason?

(Question objected to as above.)

A. We did not think from the beginning that Mr. Tilgman had a valid claim and did not want to pay any more money.

Q. 24. Any other reason?

(Question objected to as above.)

A. I think that covers the ground, but I might go a little further into detail. Mr. Collier thought we ought not to pay the royalty any longer and that that was a good time to stop, and we did not want to pay it any longer.

Q. 25. Is it not the fact that your firm was led to discontinue the payment of royalty under Mr. Tilghman's patent, or to persist in such discontinuance, by the fact that you were guaranteed or assured that your infringement, should any suit be brought against you and successfully maintained, should not cost you more than you would have paid to Mr. Tilghman as royalty, or more than some certain specified or proportionate amount?

1137 (Question objected to by solicitor for respondents as incompetent and irrelevant, and he insists upon a ruling thereon.)

The master reserves the question of competency and relevancy of the foregoing questions to which exceptions are noted, but declines to rule out the question, and requires the witness to answer, to all of which ruling the solicitor for respondents excepts.

A. When Mr. Collier took our case he did so on a contingent fee and with such a guaranty.

Q. 26. Was Mr. Collier the only party who so guaranteed you against loss, or did others join him in it?

(Question objected to as above, and same ruling excepted to.)

A. There was another party—Mr. Michael Werk.

WEDNESDAY, *March 22d.*

Examination of JAMES N. GAMBLE resumed:

Q. 27. Was the guaranty you received from Mr. Werk and Mr. Collier in writing?

A. Yes.

Q. 28. By whom was it signed?

(Question objected to as before, and same ruling excepted to.)

A. By Charles Collier and Mr. Werk. I cannot tell without examining the paper whether our firm signed it also.

Q. 29. Do you know whether any other person or persons besides those mentioned by you assumed the responsibility of this guaranty?

A. Not that I know of.

1138 Q. 30. Similar guaranties were given to other licensees of Mr. Tilghman to induce them to discontinue the payment of royalties, were there not?

A. Not that I know of.

Q. 31. Was it not represented to you that your action in declining to pay royalties and resisting the patent would influence other manufacturers to take the same stand, and thus embarrass and hinder Mr. Tilghman in the prosecution of his claim?

(Question objected to as above, and exception taken.)

A. I do not recall any such representation.

Q. 32. Did you personally negotiate the contract of guaranty, or did other members of your firm conduct the negotiations?

A. I did not personally. Mr. Wm. A. Proctor did.

Solicitor for complainant calls for the production of the contract

of guaranty above mentioned, to which the solicitor for respondents objects.

The master rules that the contract be produced, to which the solicitor for respondents excepts.

Q. 33. Can you now state the strength of the crude glycerine as it came from the digesters?

A. Generally 34° Baumé. The price at which we sold was made up at that average.

Q. 34. Can you now state, from an examination of your books, to what degree you concentrated your glycerine when you did so for customers, and what additional price you charged when you did so?

A. We concentrated it to 15° Baumé, and charged $1.55 per barrel over the price of the crude glycerine for concentrating it.

Q. 35. Please state the cost to your firm of the lime which
1139 you used in your process of decomposing fats. I mean its total cost to you at the factory where you used it.

A. I will examine the books and answer accordingly.

Q. 36. In your process of making fatty acids and glycerine as used by you during the period covered by the accounting was there any considerable deposit of sulphate of lime consequent upon the treatment of the mass as it left the digester with sulphuric acid?

A. There was a moderate amount of deposit—not large.

Q. 37. Did you treat this deposit of sulphate of lime in any way for the recovery of fatty acids which might be carried down and mixed in with it?

A. Yes; we stirred it, added sand, boiled it, and skimmed off the fatty matters that rose to the top.

Q. 38. This was the same treatment as that to which the deposit of sulphate of lime in the old lime-saponifying process was subjected, was it not?

A. I don't know of any difference, unless it be in the heating and boiling.

Q. 39. Do you know how much of the fatty acids were still entangled with the sulphate of lime after this treatment; I mean what percentage of the total fatty acids and at the time when you only used 1 per cent. of lime?

A. No; I do not.

Q. 40. It is a very inconsiderable amount, is it not?

A. It is not large.

Q. 41. What is the percentage in weight of the fatty acids produced by your process, as used from 1870 to 1875, of the total amount of fat treated?

A. I do not know.

Q. 42. Did you never make a trial, weighing the fats that went into the digester and afterwards weighing the total amount of fatty acids resulting from the treatment of the fats?

A. We may have done so some years ago, but I have no recollection of the facts or the data.

1140 Q. 43. When your firm used in the process a half pound of lime to the hundred pounds of fat was there any material dif-

ference in the quantity of fatty acids produced as compared with the quantity produced when one pound of lime to the hundred pounds of fat was used?

A. I have already said that we had no tests, but, in my judgment, in twice the quantity of sulphate of lime deposited there would be twice the quantity of fatty acids entangled.

Q. 44. Then the fact being that between the old lime-saponification process with fourteen per cent. of lime and Mr. Tilghman's process used together with one-half of one per cent. of lime, there was a difference of the quantity of fatty acid produced of two pounds to the hundred pounds of fat employed in favor of Mr. Tilghman's process; when Mr. Tilghman's process was used with the addition of one per cent. of lime the saving in fatty acids over the old lime-saponification process would be $\frac{2}{2}\frac{7}{8}$ of two pounds of fatty acids for each hundred pounds of fat treated, would it not?

(Question objected to as being in the nature of expert evidence as to facts about which the witness has made or witnessed no experiments.)

A. No; I make it $\frac{2}{2}\frac{6}{7}$ of two pounds.

Q. 45. Was your use of one per cent. of lime constant throughout the period covered by the accounting?

A. Practically it was.

Q. 46. And the quantity of sulphuric acid given in the Exhibit "Sulphuric Acid Statement" is somewhat in excess of the total quantity of acid which you used to treat the mass after it left the digester to precipitate the lime from its combination with the fatty acids as sulphate of lime?

A. Yes; it is. I stated in connection with that exhibit that such was the case. We use about three pounds of acid to the pound of lime.

Q. 47. How long have you personally been engaged in the business of manufacturing fatty acids and glycerine from fats?

1141 A. I have been a member of the firm since 1862, and have been engaged at the factory since 1859 as superintendent of a portion of the business.

Q. 48. During all this time I understand the firm has been using Mr. Tilghman's process with various modifications as to the amount of lime used with it, has it not?

A. During all this time we have been saponifying fats with hot water under pressure and with various proportions of lime.

Q. 49. Do you know by what process the firm manufactured fatty acids prior to the adoption of the process you have mentioned?

A. Yes; they saponified in a covered tub with lime and afterwards treated it with acid.

Q. 50. This was the process described by Mr. James Gamble in his testimony on pages 515–'6 Supreme Court Record, was it not?

A. Yes.

Q. 51. Did you ever see the old lime-saponification process used?

A. I have seen it. We have tried it within a week or two, but we have not used it practically since 1858.

Q. 52. Was your recent experience with it on a large scale?

A. It was on a comparatively small scale.

Q. 53. Have you had any experience with other processes of decomposing fats?

A. No; no practical experience.

Q. 54. Your firm has never used any other process besides the lime-saponification process and Mr. Tilghman's process?

A. No; except that we have used soda in some cases instead of lime, which was practically the same thing.

Q. 55. What use was made by your firm of the fatty acids produced by them?

A. They were pressed and the harder portions made into candles; the softer portion was made into soap or sold.

1142 THURSDAY, *March 23d*, 1882.

Examination of JAMES N. GAMBLE resumed:

Witness states: I desire to change my answer to question 43. I have already said that we had no tests. I now desire to state that, in my judgment, in twice the quantity of sulphate of lime deposited there might be a larger loss of fatty matters, but there need not necessarily be. In my answer to question 44 I do not wish to be understood as admitting the hypothesis of the question. My answer was simply a mathematical calculation from the facts assumed in the question.

Q. 56. Have you any reason to think any of the "assumptions" of question 44 to be incorrect, besides that founded on your answer to question 43, which you have now modified?

A. I do not know, nor do I think that any comparative tests have been made to show that there is two pounds difference in the waste by entanglement in the sulphate of lime between the old saponification process and our present process, and it being an entanglement my opinion is that thorough and sufficient washing would practically recover the fatty acid.

Q. 57. Supposing, as you have done, that it would be possible by repeated washings and treatment of the precipitated sulphate of lime to entirely free it from entangled fatty acids, in practice you would not continue this washing and treatment beyond a point when the labor expended would cost more than the fatty acids produced by it, would you?

A. I would not.

Q. 58. Will you please describe in detail, giving times and quantities, the process to which you subjected the sulphate of lime to free it from fatty acids between 1870 and 1875?

1143 A. The sulphate of lime was first secured in a tub, a quantity of cold water run in upon it, and the whole mixture stirred; the fatty acids arising to the top were skimmed off, sand was then scattered over the tub and another stirring given to it, and the fatty acids rising were skimmed off. The tub was then heated by the admission of open steam into the tub and permitted to stand until the fatty acids arose, when they were skimmed off and this

treatment repeated until little or no fatty acids were obtainable, when the residue was removed. The time required depended upon the quantity of sulphate of lime that had to be handled in the tub. Now, in 1882, we use smalier tubs and smaller quantities of sulphate of lime at a time than we did from 1870 to 1875.

Q. 59. What is the nature of the sand you mix in with the sulphate of lime?

A. It is an impure loamy sand. It will effervesce with acid. It is a sand we get from the vicinity of our work whenever cellars are being dug.

Q. 60. How many men were employed, and for how long a time, in the period from 1870 to 1875, to treat a definite quantity of sulphate of lime in the way you have described?

A. One man was employed during about four days of each week treating the sulphate of lime from about 162,000 lbs. of fat.

Q. 61. What wages did you pay the men, two-thirds of whose time was taken up in attending to the treatment of the precipitate of sulphate of lime to free it from fatty acids?

A. I will ascertain.

Q. 62. Have you yet ascertained from your books the quantity and price of the lime used by you in your process of decomposing fats during the period included in this accounting?

A. I have. The statement was prepared by J. W. Donnelly from our books.

Witness produces a statement showing the lime used in saponification fronr May 1st, 1870, to January 8th, 1875, which is introduced in evidence and marked "Complainant's Exhibit Lime Statement."

1144 Q. 63. Can you now answer question 61?

A. Yes. We paid him $10.00 per week.

Q. 64. Do you know whether the quantity of fatty acids produced by your process from 1870 to 1875 did or or did not exceed the amount of 95 lbs. to the 100 lbs. of fats treated?

A. I do not.

Q. 65. Is it not your opinion that the quantity is somewhat in excess of 95 lbs.?

A. I think it is a little, probably.

Q. 66. How much you have never ascertained, have you?

A. I have not.

Q. 67. How many pounds of glycerine are contained in such bbls. as those mentioned in your glycerine statement—I mean of the density of 3¼°, as it comes from the digesters?

A. They were 40-gallon barrels. We did not weigh them. I should estimate it at 330 lbs.

Q. 68. Was most of the glycerine sold by your firm during the period of the accounting shipped as crude glycerine, or was it generally concentrated before shipment?

A. I think it was nearly or quite all concentrated to 15° before shipment.

Q. 69. Do I understand you correctly, that you sold this glycerine

at so much per bbl. of crude glycerine and charged an additional amount per bbl. for concentrating it to 15°?

A. In substance, that. We sold it at so much per degree per bbl., and concentrated it to 15° for an additional charge.

Q. 70. What was the price per degree.

A. It varied from 25 cents to 72½ cents per degree.

Q. 71. What was your charge for concentrating a bbl. of 3¼° to 15°?

A. $1.55 per bbl. of 15°. One test I have made shows that 6½ bbls. of 3° or 3¼° make one of 15°. I am not sure whether it was 3° or 3¼, as the memorandum of it states that it was 3°, while
1145 the price indicates 3¼°, and I am not sure which is right. That is the only test I have any record of. A repetition of tests would have given a more satisfactory basis.

Q. 72. Did you ever sell any crude glycerine of a density of ½° Baumé, or do you know of any such glycerine being sold?

A. No.

Q. 73. Did you ever sell any of 1° Baumé, or do you know of any such being sold?

A. No.

Q. 74. Or of 2° Baumé?

A. I can't be sure of that. We have sold some crude glycerine, and some of it may have been as low as that, but not during this term from 1870 to 1875. As to the price I cannot say.

Q. 75. How many pounds of lime were contained in the bbls. included in your "lime statement," and what was the average cost to you per pound?

A. I estimate the weight to be 320 pounds per barrel, and make the cost $35\frac{26}{100}$ cents per hundred pounds, delivered at the factory.

Q. 76. Can you now produce the contract of guaranty spoken of in your former testimony?

A. I now produce it.

The contract is offered in evidence as complainant's exhibit, marked "Collier and Werk Guaranty," and it is stipulated and agreed between counsel that a copy of same be made by the master and marked as above, to be herewith filed and used as, and instead of, original, subject to the same exceptions; and the same is accordingly done.

Q. 77. Has this contract ever been modified or changed since the date of its execution?

A. Not that I know of.

Further examination of James N. Gamble suspended by consent.

1146 JAMES GAMBLE sworn and examined by F. T. CHAMBERS, Esq., solicitor for complainant:

Q. 1. State your name, age, residence, and occupation.

A. James Gamble; 78 years of age; reside in Cincinnati, Ohio, and am a member of the firm of Proctor & Gamble, the respondents.

Q. 2. How long have you been a member of that firm, and engaged in the business of manufacturing candles?

A. Since 1837.

Q. 3. How did treat fats then?

A. We did not make star candles until 1850; we made tallow candles up to that time. When we first made star candles we treated the fats by the lime-saponification process in covered tubs made as tight as we could, but not sufficient to give a strong pressure.

Q. 4. The process then used by you and the one subsequently adopted were as described by you in your testimony printed on pages 515 and 516 Supreme Court record, were they not?

A. Yes; with the exception, I think, that we decreased the amount of lime to 13 pounds at one time before 1858; but I am not certain about that.

Q. 5. What did your firm do with the glycerine produced during the time you used the lime-saponification process prior to 1858?

A. We ran it away—let it go to waste—because we knew nothing of glycerine.

Q. 6. You sold no glycerine, then, prior to 1858?

A. No; and very little after that for a good while. When we commenced manufacturing glycerine there was no demand for it and we could not sell it.

Q. 7. When did you begin to sell it?

A. I suppose in the latter part of 1858. When we began to use the closed tank we continued to waste the glycerine until a man came along who said he could save it.

Q. 8. What strength was the glycerine produced by the process you adopted in 1858?

A. I think it was 3° Baumé.

1147 Q. 9. When you were using the old lime-saponification process prior to 1858, was not the decomposition somewhat irregular—that is, would there not sometimes a portion of the fat escape saponification by the lime and cause in the fatty acids produced a less perfect crystallization due to the mixing of undecomposed fats therewith?

A. I think not; I think we had no trouble that way; but, if an insufficient quantity of lime or acid were used that might be the result. The old process left our cakes cleaner than the new.

Cross-examination by R. H. PARKINSON, Esq., solicitor for respondents:

X Q. 10. When did glycerine become a commodity in demand in the market?

A. I could not tell exactly; we found we could not sell it in the market and sold the crude glycerine as it came from the tank to Mr. Gordon.

X Q. 11. Has there been any increase in the extent to which glycerine is used within the last twenty or thirty years?

A. There has been a very great increase. Very little was used when we began to manufacture it.

X Q. 12. To what purposes, if any, is it now applied for which it was not used twenty years ago?

A. I could not tell. It is now used in manufacturing tobacco and in making nitro-glycerine dynamite. There are a good many uses of which I know nothing.

X Q. 13. Was there any actual waste of the fatty acids in the old lime-saponification process?

A. I think there was no waste, but we did not get the same quantity as put in, for the glycerine was wasted, and also any sediments there might be in the grease. I think it would be impossible to tell by weighing the stock the loss in this, from the fact that sometimes it will hold more moisture than at others.

1148 X Q. 14. Was there more or less fatty acid obtained by the old process used by you prior to 1858 than by the process used by you since 1870?

A. I think there would be no difference if the fatty acids from the tank in the new process is well settled, but it won't settle as well as in the old. In actual practice there is more weight in the product of the new process, as it contains more sediment than from the old, but I think the amount of fatty acids in each is the same.

X Q. 15. Do you know whether or not this sediment is subsequently taken out by any process through which the fatty acids pass in the manufacture of soap or candles, or whether it remains in these articles when sold?

A. I think it is taken out, but a great deal of the color remains. Our stock is not as good a color in the new process as in the old for stearic acid or oil.

Direct examination resumed by F. T. CHAMBERS, Esq.:

Q. 16. Do you know how many pounds of fatty acids were practically produced from 100 pounds of fat treated by the old saponification process used by you prior to 1858?

A. We always made a calculation of 95 pounds, but I cannot say more than that.

Q. 17. Do you know how many pounds of fatty acids were practically produced from 100 pounds of fat treated by the process used by you from 1870 to 1875?

A. We calculated the same.

Q. 18. Was this calculation or estimate founded upon any tests made by your firm or under their direction?

A. No, sir. I do not think a test practicable; it is no more than guesswork.

Q. 19. So far as you have any actual knowledge, there may have been a difference in the weight of fatty acids produced from 100 lbs. of fat treated by the old saponification process and the process as used by you from 1870 to 1875, may there not?

1149 A. I think when we have examined and find the lime all clear of the acids the product in each case must be the same, except as to the sediment remaining in the tank-stock.

Q. 20. Are you able to swear that the lime precipitate in your

neutralizing tubs, as you used the process prior to 1858, was entirely and thoroughly free from any fatty acids before it was carted away?

A. When we ran it into the lime tub, prior to 1858, there was a good deal of fatty acid remaining in the lime precipitate. We then added sand and stirred it well, and took off all the acids. Then we took off some of the lime stuff, added water, stirred well, and if we found no trace of fatty acid, considered it entirely free from such acid and let it go. We treat and test it in the same way now.

Q. 21. Did you, prior to 1858, heat the mixture of lime stuff, sand, and water in the lime tub?

A. No, sir; but throwing the sand in makes it hot. The sand is put in cold, but the acid takes hold and makes an ebul-ition.

Q. 22. Do you not know whether, after the test which you say you made had been tried and no fatty matter had risen to the top of the water, the lime stuff still held some fatty acids so tightly entangled with it that this test would not free it, do you?

A. I could not say. That was our test. Whenever we found any acid rise to the top we added more sand and stirred it, and when no more fat rose we believed it to be perfectly clear.

WILLIAM A. PROCTOR sworn and examined by F. H. CHAMBERS, Esq., solicitor for complainant.

Q. 1. State your name, age, residence, and occupation.

A. William A. Proctor; 47 years of age; reside in Glendale, Ohio, and am a member of the firm of Proctor & Gamble, the respondents in this suit.

1150 Q. 2. How long have you been a member of the firm, and what prior connection, if any, had you with the business?

A. A member of the firm since 1859, and for eight years previously had been employed at the factory.

Q. 3. You negotiated the contract, "Collier & Werk Guaranty," on the part of your firm, did you not?

A. I did.

Q. 4. When did those negotiations commence?

A. Only a short time before the contract was signed; I should think not more than a month. I had conversations with Mr. Collier, however, for some time, leading to it.

Q. 5. When did you first talk with Mr. Werk on the subject?

A. I never talked with Mr. Werk on the subject; I don't think I ever did.

Q. 6. Did Mr. Werk execute the guaranty without ever mentioning the subject to any of your firm?

A. To the best of my knowledge, he did.

Q. 7. The negotiations with Mr. Werk, then, were conducted through Mr. Collier, as his agent, were they not?

(Question objected to by solicitor for the respondents as assuming that Mr. Collier acted in the character of agent for Mr. Werk.)

A. We had no negotiations with Mr. Werk.

Q. 8. Did not Mr. Collier represent to you that Mr. Werk had au-

thorized him to make certain representations to you, and to promise that he would guarantee Mr. Collier's guaranty?

A. He did not.

Q. 9. Did Mr. Werk volunteer to make the contract of guaranty?

A. I do not know.

Q. 10. Did Mr. Collier tell you before you signed the paper that Mr. Werk would sign the agreement which he did sign?

1151 A. He did; and I think the paper was signed by both Mr. Collier and Mr. Werk before I signed it. I am very confident of it.

Q. 11. You know, do you not, that a number of other licensees under Mr. Tilghman's patent ceased to pay royalty and throw up their licenses at about the same time your firm did so?

A. I do not know of any firm doing so.

Q. 12. Was it not represented to you while this contract was being settled that your action would influence others to resist the patent?

(Question objected to by the solicitor for complainant and exception taken.)

Q. 13. You were with the firm for a number of years before they commenced the use of the process of decomposing fats by water at a high temperature and pressure, and while they were still using the old lime-saponification process, were you not?

A. We never used water alone. I was there while the firm was using the old lime-saponification process.

Q. 13. The firm sold no glycerine while using that process, did they?

A. No.

Q. 15. Do you recollect what strength the glycerine water produced by the old process had?

A. I do not.

Q. 16. Do you recollect how many pounds of fatty acids were produced from 100 lbs. of fat by the old process? I mean practically produced, so as to be available in candle and soap manufacture.

A. 95 to 97 lbs., according to the cleanliness of the stock.

Q. 17. Did you weigh the products?

A. We did.

Q. 18. Have you the record of such weighings?

A. I have not.

Q. 19. When did you last see such records?

1152 A. When I made them, myself; I was foreman in the factory, and made weekly and monthly statements, which I kept for my own guidance, and to ascertain the cost of candles; I gave the cost to the store from those figures.

Q. 20. What have you done with those statements?

A. They are not in existence, and have not been for twenty years, I suppose.

Q. 21. Are you able to swear that when the firm was using the lime-saponification process, and employing fourteen per cent. of lime to the 100 lbs. of fat, that in some instances you found, by actual experiments made on the regular products of manufacture, that a

weighed quantity of 100 lbs. of fat yielded 97 lbs. of free fatty acids, all suitable for use in the manufacture of candles and soap?

A. All I can state is, that my basis of calculation was on those tests, and I have always relied upon them.

FRIDAY, *March 24th*, 1882.

Examination of WM. A. PROCTOR resumed:

Q. 22. Please state in what manner you weighed the fatty acids produced by the lime-saponification process, in order to ascertain what proportion they bore to the fat treated.

A. I had what I called a monthly stock-taking—my recollection is that it was monthly—of the stock treated and the products weighed out.

Q. 23. Did you weigh the total product of fatty acids for the month or only a portion of it?

A. We did both; we kept a monthly record of all treated, and also made special tests occasionally.

Q. 24. What facts were shown by the monthly record kept by you?

A. The cost of candles was arrived at by the amount of candles produced and the amount of red oil.

Q. 25. What did you do with your red oil?

A. Sold a portion and made soap of the balance.

1153 Q. 26. This monthly record was not a record of actual weights, was it?

A. It was.

Q. 27. Where did you weigh the products of fatty acids?

A. The stearic acid as it went to the moulding tub, and the red oil as it was sold or went to the soap tub.

Q. 28. That is, after separating the red oil from the stearic acid by pressure, you removed it to a weighing apparatus and then moved it again to the soap vats or kettles; is that what you mean?

A. The oil as it came from the presses was received in a tub, from which it was barreled, and then shipped or sent to the soap factory, being weighed as it went out.

Q. 29. Where was your soap factory?

A. In a separate building, about 50 to 100 feet from the candle factory, where the presses were.

Q. 30. And to move this oil 50 or 100 feet you barreled it?

A. We did; the business of the candle factory and the soap factory was kept as distinct as though operated by different persons.

Q. 31. Was the fat acid product and stock used for each month kept entirely distinct from that of the preceding and following month?

A. The stock on my manufacturing book was kept separate—that is, the raw material treated during the month was taken—and when the stearic acid and red oil were produced my figures of costs were made therefrom.

Q. 32. Was the fat acid product for each month weighed and kept distinct from that of the preceding and following months?

A. It was, as detailed in my former answer; when the raw material was weighed in and the amount ascertained, the results were determined when it had been pressed and the stearic acid and red oil weighed, which was generally ten days or two weeks later, this time being necessary to complete the process of manufacturing stearic acid and red oil from the raw material treated.

1154 Q. 33. You did not at the end of the month's working stop the use of new raw material until the fatty acids produced from that used during any one month had been completely manufactured, separated, and weighed, which, as I understand you, took from ten to fourteen days?

A. We did not.

Q. 34. Then the fatty-acid products of the raw material used during any one month was not kept distinct from the product of the raw material used during the preceding and following months?

A. Of course it was. The record of the product was kept separate. The product itself was not kept separate.

Q. 35. Your record, as I understand, would show the exact quantity of fat material treated during any one month, say from the 1st to 31st of March, inclusive, and would also show the quantity of fatty acids produced during the same period. The same facts would be shown for the month of April. But your process going on continuously, I do not understand how you could distinguish the fatty acids produced from the fats which you began to treat on the 31st day of March from the fatty-acid products of the fats which you began to treat on the 1st day of April. Will you please explain this?

A. In the first place my record was not kept by calendar months, but by periods of weeks, generally ending on Saturday night and beginning on Monday morning. It was comparatively easy for us to keep the material for one period separate from that of another, and the correctness of these was verified by taking a number of tests together, say from one annual stock taking to another.

Q. 36. The weight of the stearic acid and red oil was taken as and when it left the factory for use or sale, was it not?

A. The stearic acid was weighed at the moulding tubs, the red oil as it was sold or used.

Q. 37. Besides these monthly statements you made occasional tests, I understand; describe how these were made.

1155 A. The tests were the similar monthly tests on special lots of raw material with tests for yield of stearic acid from the hydraulic presses to determine the value of certain lots of raw material.

Q. 38. In these tests you did not weigh the red oil too, did you?

A. Practically we did, by weighing the material into the press and the resulting products out of it. We weighed the stearic acid and the margaric acid and the difference was the red oil.

Q. 39. How great a quantity did you take in making these tests?

A. I do not recollect, but probably 1,000 lbs.

Q. 40. How many pounds of fat were there in an ordinary batch or cooking in the old lime-saponification process?

A. From five to six thousand pounds.

Q. 41. When you made these tests you used a batch of only 1,000 lbs.?

A. No. The test of 1,000 lbs. mentioned was a test of that quantity of decomposed fats ready for pressing and taken from the settling tub, which would contain the product of one or two cookings.

Q. 42. You would not know accurately, then, how many pounds of raw fats had been used to produce this 1,000 lbs. of material you took from the tub?

A. Not this identical 1,000 lbs.

Q. 43. Do your firm still keep such a record as that which you have stated you kept during the period you used the old lime-saponification process?

A. It does not. I have not had charge of the candle manufacturing for more than ten years. During the time we were using the old saponification process my partners and myself were learning the business, and I was especially desirous to do so.

Q. 44. When did the firm cease to keep such a record?

A. I kept it for two or three years, but can't give the date when I ceased to do so. The firm never kept such a record, but I kept it for my own satisfaction and instruction while I was learning the business.

1156 Q. 45. You did not continue to keep such a record so late as 1858, when you adopted the new process, did you?

A. I do not think I kept this kind of a record after 1857.

Q. 46. Mr. James Gamble had immediate control and direction of the factory during the time you kept this record, did he not?

A. More especially of the soap factory than of the candle factory.

Q. 47. Have you ever made any test as to the percentage of fatty acids produced from fats treated since you ceased to use the old lime saponification process?

A. I have not.

Q. 48. In the old process, as well as in the new, there was, besides the stearic acid and the red oil produced, a quantity of a substance called margaric acid, separated in the hot press, was there not?

A. There was, but usually termed hot-press grease.

Q. 49. What was done with this hot-press grease or margaric acid?

A. It was worked over again by being mixed with the neutralized lime soap in the settling tub.

Q. 50. The margaric acid was always carried back and mixed with the fresh products of the saponifying and neutralizing fats, was it not?

A. Yes; together with broken cakes and crumbs not in shape to go into the press.

Q. 51. About how many saponifying vats did your firm have in use prior to 1858?

A. I think two or three.

Q. 52. How long would the material being treated remain in these vats from first to last?

A. We aimed to make one operation every twenty-four hours—the material remained in the vats about that time.

Q. 53. What was the next step in the manufacture of this material?

1157 A. It was shoveled out of the saponifying vats into a neutralizing vat, which was lined with lead and contained a quantity of sulphuric acid and water. In this vessel it was boiled by the introduction of free steam until the lime was separated from the fat, and samples of the fat acid taken out and cooled showed the proper crystalline appearance.

Q. 54. How many such tubs were there, and how long did the material remain in them from first to last?

A. One or two. The material remained in those tubs also about twenty-four hours.

Q. 55. What was done with the material after it left the neutralizing tubs?

A. The fat acids were drawn off into a settling tub by means of a syphon, except the latter portion, which was dipped off from the surface of the water into a hogshead or hogsheads. The sulphate of lime remaining in the bottom of the tub was let out through the bottom into a wooden tub. The fat acid *that* was run down by the syphon into the settling tub, along with that from the hogshead when settled (I would say that the hogsheads were used to receive that portion of the fat acid that was not removed by the syphon, and was liable to contain more or less water and dirt). Upon being well settled, which would take two or three hours, the clear fat acid was run down into the settling tub and the remainder of the fat acids and water left in the hogshead were turned back into the neutralizing tub. The contents of the settling tub was then boiled or washed with water and open steam, and, when clear and thoroughly settled, was run into tin pans containing about twelve pounds each. There were two settling tubs and the fat acids remained in them from twelve to twenty-four hours. The sulphate of lime and acid water that were run into the wooden tub were treated by being thoroughly stirred together with an addition of sand, and the fat as it rose to the surface was skimmed off. This fatty acid was taken back to the neutralizing tub. The sulphate of lime was treated until all the fatty acid was recovered; we call it yard grease

1158 when recovered from the sulphate of lime; it was, of course, the same as the other fat acid, but contained more dirt. This treatment required a man the greater part of a day of ten hours.

Q. 56. How long was the fat acid from the settling tubs left in the twelve-pound pans, and for what purpose?

A. From twenty-four to forty-eight hours, until sufficiently cooled for pressing. The purpose of leaving it in the pans is to permit the stearic acid to crystallize.

Q. 57. What is done with the contents of the pans when the fat acids have sufficiently cooled therein?

A. The cake is wrapped in a woolen cloth and subjected to hydraulic pressure—first, in a cold press, when the red oil is expressed,

and secondly, in a hot press, when the margaric acid or hot press grease is expressed. The resultant cake is stearic acid, which is removed from the woolen cloth and placed in barrels ready for the moulding tub. I would add that the cakes from the pans, before being pressed, are sometimes piled on platforms in the cellar until the press is ready for them.

Q. 58. The cakes, when stored in the cellar, are piled one on top of the other, are they not?

A. They are, and each pile marked with the date on which the fat acid was run into the pans, the object of the dating being that the oldest shall be pressed first.

Q. 59. When these cakes are piled up, as you have stated, more or less drainage of red oil takes place from them, does there not?

A. There may be at some seasons of the year a little oil run out, which is caught and returned to the neutralizing tubs.

Q. 60. How long does the operation of pressing the fatty acids take?

A. It varies considerably, some fat acid yielding the oil more readily than others. It should have an hour in the cold press and half an hour in the hot press. The pressing in the hot press takes place immediately on leaving the cold press.

Q. 61. You spoke some time ago of the sulphate of lime from the neutralizing tubs being stirred in the wooden tubs until all
1159 the fatty acids were extracted from it. What reason have you for thinking that all the fatty acids were extracted?

A. Our desire being to prevent waste we washed it very thoroughly in the lime-tub, until we could obtain no more fat. Mr. Gamble, Sr., kept a close watch over this lime-washing tub as well as myself.

Q. 62. When you say that all the fatty acids were removed then you mean that all which a thorough washing of the sort you have described would remove were removed?

A. I mean that all the fatty acids were removed.

Q. 63. Did you ever have the sulphate of lime analyzed to ascertain whether it still held any fatty acids after being subjected to the washing you have described?

A. I do not recollect of any chemical analysis having been made, but it may have been done.

Witness desires to add to the answer made to question 51: In these saponifying vats five or six thousand pounds of raw material were treated at a time. The vats were of double the size necessary to hold the raw material. A steam pipe was laid in the shape of a circle on the bottom about six inches from the side of the vat; also a steam pipe was brought down from above to the center of the bottom of the vat, and six branches were attached thereto. All the pipes, as they lay on the bottom, were perforated, so as to allow free exit of the steam. After the raw material had been thrown into the tub and melted and heated a mixture of lime and water of about the consistency of milk or cream was thrown in upon the fat; also a quantity of water run in, and the vat covered with boards, and

weights laid upon them. After boiling about six or eight hours, according to the quality of the steam, the process was considered finished. The next morning the glycerine water was drawn off, and when the lime soap was cooled down it was shoveled over into the neutralizing vats.

1160 Further taking of the account adjourned by consent to Monday, March 27th.

MONDAY, *March 27th*, 1882.

Examination of WM. A. PROCTOR resumed.

The witness continues his additional answer to question 51:

We sometimes made extra operations or cookings in these tubs by running cold water upon the lime soap in order to cool it, so that it might be shoveled into the neutralizing vat. In the neutralizing tub we found, first, after the operation of neutralization had been perfected, the fat acids; then a stratum of water which contained sulphuric acid and glycerine that had been removed from the lime soap, and below this the deposit of lime or sulphate of lime. A certain portion of this water was used over in the succeeding charge for the purpose of economizing the use of acid.

Q. 64. The saponifying tubs were large enough to contain about double the quantity of fat you put in them, I understand?

A. They were.

Q. 65. About how much water was put into these tubs, along with the fat?

A. A little less than the volume of the fat, so that the vats were almost full. It was calculated that the condensed steam would supply water enough to keep them full.

Q. 66. When the cooking of the mass in the saponifying tubs was completed the tubs were about full of lime soap and water, I understand?

A. They were not full, there being space enough to allow for the boiling of the water without excessive flashing out; that was
1161 all. The water in the vat, when the operation was through, was about equal to the bulk of the fat that had been put in.

Q. 67. You have spoken in your former testimony of what you call crumbs from the cakes of fatty acid, which you stated were returned to the settling tubs. Please state what these crumbs are.

A. They were the edges of the cake of stearic acid as it came from the hot press, which sometimes, from inequalty of pressure, had a little red oil remaining, and might discolor the candles if thrown directly into the moulding-tub.

Q. 68. Almost every cake as it leaves the hot press is discolored on its edges, is it not?

A. It is not.

Q. 69. What proportion do you think are so?

A. Two or three per cent.

Q. 70. Do you mean that only two or three cakes out of a hundred will have any of this discoloration on their edges?

A. No; I mean that some cakes will not have any discoloration, but that in a day's work two or three per cent. of the stearic acid would be a fair amount of the crumbs.

Q. 71. The records which you made prior to 1858 of fats treated and fatty acids produced were used, I understand, in making up the yearly stock-taking. Will not some of your books or papers show what this stock-taking was?

A. I never said that the monthly records that I kept were used in making up the annual stock-taking. It was a mistake if I did so.

Q. 72. Have you still got the record of the annual stock-takings?

A. I do not know, but I hardly think we have. I will look for them and produce them if they can be found.

Q. 73. Has the annual stock-taking been taken every year by your firm?

A. It has.

1162 It is stipulated and agreed by counsel that the remainder of the testimony may be taken stenographically, and M. J. Day is agreed upon by counsel and appointed by the master to proceed with the testimony.

Q. 74. What do these annual stock-takings show?

A. The profits and losses in our business.

Q. 75. Do they show the quantity of fats treated?

A. They do not.

Q. 76. Do they show the quantity of fatty acids produced?

A. They do not. What was the question?

Q. 77. Do they show the quantity of fatty acids produced?

A. They do not. Maybe you and I are talking about different things.

Q. 78. Possibly we are.

A. By stock-taking I mean showing the result of the business, arriving at the profits and losses as a whole; of course, there are other books which show the amount of stuff received in the factory and the amount sent out—for instance, the amount of stearine and tallow used by the factory, but not in our stock-taking.

Q. 79. What do you call such statements as show the fats treated and the products of the business; how are they made up?

A. There are no such statements made up at the present time. They could be compiled from our books. I could probably give you a little fuller understanding by extending the answer. The amount of fats treated would be determined from our tank-book, and the amount of candles and oil produced would be shown from our shipping books, regular accounts, regular office books. I don't know what you would term them.

Q. 80. Would any of your books or accounts show the amount of fatty acids produced?

A. No, sir; they would not; because they are not a finished product and would not go upon our books on that account.

1163 Q. 81. You stated that when you were making up your monthly statements prior to 1858 you made such statements

by periods of weeks. How many weeks were included in your statement?

A. My recollection is, about four weeks.

Q. 82. Please state in detail how you made up a statement and exactly what facts it showed.

A. I took the amount of fat treated from the charge-book. By the charge-book I mean the amount weighed into each operation or cooking. At that time the work was done by contract, so much per thousand. I then, at the end of the period for which I had determined to draw my line or make my figures of cost, taking when the stock was all panned off belonging to it—was in the pans and pressed—I took from the moulder the amount of stock that he had weighed in its moulding-tub from the last period, also the amount of tallow used as adulteration, and from the shipping-books any oil that was sold as oil, and from the soap-factory books any oil that was delivered to the soap factory, being careful to get back all the hot-pressed grease, crumbs, and stock that belonged to that period. When there was any stock that could not be worked into that period that was weighed and added as belonging to it, and then, with the expense of labor and wick, I was able to determine the cost of candles.

Q. 83. This course you pursued for each four weeks, consecutively, for a number of years?

A. I did it for consecutive periods for two or possibly three years, while I was learning the business.

Q. 84. You did not stop the operations of the factory at all between those periods?

A. No, sir; it was not necessary to do so. I might give an answer a little more in detail if you like.

Q. 85. Certainly.

A. At this period of our business we had a large building built for this purpose and with a view of largely increasing our work, and were not doing probably half as much as we had the capacity to do; therefore I had ample facility to work at my problems and costs.

1164 Q. 86. How many pounds of fat were you treating per week during the time you kept these accounts?

A. I should say from fifty to seventy-five thousand pounds.

Q. 87. The period you are speaking of is a long way off; do you think your memory is entitled to be depended upon in regard to the matters of which you have spoken?

A. I think it is, as I have been continually in the business; touching the matter specially of obtaing the cost of candles, it was my school; what I went there for and the knowledge obtained there I have been using every year since that time.

Q. 88. You have stated that to the best of your recollection your firm had, during the period of which we are speaking, but one saponification tub, possibly two; that the charge put into this tub or tubs was from five to seven thousand pounds of fats; that it took twenty-four hours to comple the operation of saponifying the fats in this tub; you have also stated that you treated from fifty to seventy-five thousand pounds of fats per week during this period; even sup-

posing that you had two saponification tubs at work, this quantity would be in excess of their capacity, would it not?

A. You misstate my answer; my answer to question 51 was, I think, two or three saponifying vats, not one or two. Possibly you mistake my answer in regard to twenty-four hours. I mean that during the twenty-four hours one full operation is begun and ended and ready to start the next, and I think arithmetic will bear out the correctness of my answer on that ground. I stated in my amended answer this morning that we could lessen the period of twenty-four hours by cooling with water when necessary.

Q. 89. Since you were constantly returning the margaric acid from the hot presses, the crumbs from the hot press, and the broken cakes from the pans to the settling tub, how was it possible for you to ascertain correctly that the fatty acids produced up to any given date were the products of fats treated up to any certain time?

1165 A. Because that was what I was there for, and, with the advantage of my assistants, I kept close watch and did it correctly. As I stated before, one period or month's work would verify another, and the year would verify the whole.

Q. 90. I can easily understand how you could obtain a reasonably fair average as the result of a year's careful observation, such as you describe, but I do not see how you were enabled to ascertain the exact fatty-acid product of any certain quantity of two or three thousand pounds of fat which you treated during a single period of four weeks, and I understood you to say that your statement would show this. Was I correct?

A. My statement was, and is now, that I weighed the raw material used during a certain period of weeks or months in and weighed out the amount of red oil and candles, thus determining the amount of free fatty acids obtained from a given amount. I did not take averages, but took actual weights.

Q. 91. What sort of fats were you using when you kept these accounts?

A. Principally lard stearine. My impression is we used nothing else.

Q. 92. Lard stearine is a very clean fat, is it not, usually?

A. Prime lard stearine is.

Q. 93. This was the principal sort of fat used by all the soap and candle makers in Cincinnati at that time, was it not?

A. My recollection is that it was.

Q. 94. What is your recollection as to the average yield of fatty acids from the fats treated by you with the old saponification process?

A. About ninety-five per cent. Sometimes it ran as high as ninety-seven.

Q. 95. Under what circumstances would it run as high as ninety-seven per cent.?

A. On very clean stock and very perfect operation.

Recess until 2 o'clock p. m.

1166 Afternoon session.

Q. 96. The process of decomposing fats used by you prior to 1858 was substantially the same as that used by other candle and soap makers using the old lime-saponification process, was it not?

A. I cannot answer that.

Q. 97. Before the execution of the Exhibit "Collier and Werk Guarantee" you had been in correspondence and communication with R. G. Mitchell and other candle manufacturers who were using Mr. Tilghman's process relative to the question of your liability under the said patent, had you not?

A. I am not aware that Mr. Mitchell was using Mr. Tilghman's process. I understood that he was using the Wright & Fouché process. I do not recollect of being in correspondence, but possibly may have been in correspondence with other manufacturers upon the topic of infringement of Mr. Tilghman's process; I am rather inclined to believe we were not.

Cross-examination by Mr. PARKINSON:

X Q. 98. What advice, if any, had you obtained as to the validity of the Tilghman patent or as to whether it covered the method of manufacture used by you before you stopped paying royalty?

A. Mr. Collier was out here and expressed himself to me as very sanguine of defeating Mr. Tilghman, and that he would gain Mr. Werk's case for him, and that Mitchell would also gain his case. Mr. Collier represented to me that they had some new evidence, strong, and that he felt very sanguine that he would be able to defeat Mr. Tilghman. After seeing him two or three times, incidentally meeting him one day, he invited me to call and see him at his room in the Burnett House. I did so, and there he uged the

1167 point that he was very sanguine and sure of gaining the case, and said we were foolish to continue to pay royalty; that he would be willing to defend us for what we would pay Mr. Tilghman in one year, leaving four or five years unpaid—that is, I mean escape the payment of four or five years, the balance of the life of the patent. I said we were getting along amicably, and I did not care very much for war, but certainly, if he thought that way, it was worth consideration. He said, "Well, if you will pay me five thousand dollars I will guarantee that you shall not have to pay Mr. Tilghman anything upon this patent." I said to him then, "Suppose we do not succeed, we will then have to pay him." "Well," he says, "I will guarantee if we do not upset his patent, all you will be required to pay him is what you would pay him under the license with interest." "Well," says I, "Charlie, what is your guarantee worth?" "Well," says he, "that is a pretty square sort of a question." I says, "It is, but it is business." Well, he thought a little while and says, "If I get Michael Werk to go security, will that be satisfactory to you?" I says, "It will." He says, "All right." I says, "I will propose it to my partners," and did so. I think he was going away at that time; I do not recollect just now, but the result was that he brought me this paper that has been offered in

evidence, and Mr. Werk had signed it, but Mr. Collier had put in it a little more than Mr. Werk wanted, putting in something about his own patent—he seemed very fond of it, something that he did not want to ignore—and they erased that much. So we accepted the paper, and the result was that the case within a year was decided in the Mitchell case, and we had the issue in the district court dismissed. I do not know whether you call it a dismissal or not, and we paid Mr. Collier his five thousand dollars, less the retainer fee.

X Q. 99. What, if any, information had you at the time about the character of the evidence as to the invalidity of the Tilghman invention that had been introduced in the Mitchell case in New York?

1168 A. Only a general report or statement from Mr. Collier of new evidence that he was able to bring to bear upon the case, and a very hopeful, sanguine statement of the probabilities, — we felt like risking five thousand dollars in the venture.

X Q. 100. Had you or had you not any information as to what attorneys were conducting the defense in the Mitchell case, or as to what opinions they had given as to the effect of the evidence produced there?

A. I think that names of the attorneys, and that they were prominent ones, were mentioned, but I do not recollect now the names.

X Q. 101. Question 100 read to witness.

A. I only recollect that Mr. Collier made a general statement of gaining his case. I do not recollect details of opinions, evidence, or testimony.

X Q. 102. You can make any further statement you desire now.

A. Well, I will make a statement in connection with this contract. Since the master was appointed, we notified Mr. Collier and Mr. Werk of the position of the case, and that a master had been appointed; Mr. Collier has not found time to reply to our letter; Mr. Werk came over immediately and says, "What is this?" I said "This is the contract you signed; you went upon Mr. Collier's security." Why he says, "Well, is that so?" Says he, "I most forget; it was somewhere in my head that I did do that thing, but I do not recollect it." Says he, "I would like to see that paper," so the paper was locked up in Mr. Ramsey's safe and I did not get it for a few days, but I got it and gave it to him, but I have not seen it since. That is the whole thing of the paper; another thing, the paper has never been out of our possession or shown to any person at all; in fact, it might be said to have been almost forgotten, as it was stowed away in our safe among other documents.

Adjourned until to-morrow, Tuesday, March 28th, 1882, at 10 a. m.

1169 TUESDAY, *March 28th*, 1882—10 o'clock a. m.

Met pursuant to adjournment.

JAMES W. DONNELLY produced, and being duly sworn, testified on behalf of the complainant as follows:

Examined by Mr. CHAMBERS:

Q. 1. State your name, age, residence, and occupation.

A. James W. Donnelly; residence, No. 1002 Scott street, Covington, Ky.; occupation, clerking at Proctor & Gamble's factory.

Q. 2. Please examine the "Exhibit Sulphuric Acid Statement" and state whether it was prepared by you, and if so, how you prepared the same?

A. (Witness examining exhibit.) I prepared this statement from the books of Proctor & Gamble, at their factory office.

Q. 3. Who instructed you to prepare the statement?

A. I was instructed by Mr. James N. Gamble, of the firm of Proctor & Gamble.

Q. 4. Are you able to swear that this statement correctly shows the amount of sulphuric acid used in the process of decomposing fats into the fatty acids and glycerine during the period included in it?

A. To the best of my knowledge and belief, the sulphuric acid included in this statement was all used in the decomposing of fats and glycerine in the time included within this statement.

Q. 5. Was your examination of the books sufficiently thorough to enable you to state that no more acid than the quantity mentioned in the statement was used in this process?

A. Yes, sir; it was.

Q. 6. Did you prepare the "Exhibit Glycerine Statement?" And if so, state from which of the defendants' books you prepared the same.

A. (Witness examining exhibit.) I prepared this state-
1170 ment. I got it from two books, a part from what is known as the glycerine book, and a part from what is known as the day book.

Q. 7. Does the statement correctly show what the crude glycerine manufactured by the respondents during the period included in it, and the price received by them for such crude glycerine?

A. It does; yes, sir.

Q. 8. Please examine the "Exhibit Fat Statement" and state whether it was prepared by you; and, if so, from which of the respondents' books it was prepared.

A. (Witness examining exhibit.) I prepared this statement of fats saponified a part from the saponification book and a part from the day book.

Q. 9. Does it correctly show the amount of stocks saponified during the period included in the accounting, and the character and price paid for such stock?

A. It correctly shows the amount, character, and price of stock during the time included in the statement.

Q. 10. Please examine the "Exhibit Lime Statement" and state whether it was prepared by you; and, if so, from which of the defendants' books.

A. (Witness examining the exhibit.) I prepared this statement of lime used in saponification from the ledger and day books of Proctor

& Gamble, except the last item—"Drayage, 10 cts. per barrel"—and it correctly shows the amount of lime used in saponification under the dates in the statement, and it correctly shows the price and the cost of freight of the lime.

It is stipulated between the respective parties that the witness shall sign the stenographer's notes, which was accordingly done.

(Signed) JAMES W. DONNELLY.

1171 JAMES N. GAMBLE recalled and examination resumed.

By Mr. CHAMBERS:

Q. 78. Please examine the "Exhibit Lime Statement," and state whether the entry at the end thereof, which reads "Dayage, 10 cts. per barrel, $112.70," is in your handwriting, and whether it correctly states the cost of the drayage of lime used in the process used by your firm in and during the period of accounting.

A. The item "Drayage, 10 cts. per barrel, $112.70," at the end of this account is in my writing. That was the cost of the drayage at that time, and correctly represents what the drayage cost us.

Q. 79. You have stated that the glycerine sold by you during the period accounted was concentrated from three and a quarter to fifteen degrees Baumé. Please state how this concentration was effected.

A. By boiling in an iron vat with a close steam-coil.

Q. 80. You have stated that one experiment made by you showed that six and a half barrels of glycerine, at three or three and a quarter Baumé, were required to make one barrel of glycerine at fifteen degrees. In your opinion, does this approximately show the average proportion, or do you think that a different ratio would ordinarily prevail?

A. Well, in my opinion, it shows approximately. I stated in my former answer that if there had been a larger number of experiments we would have had a better opportunity for approximating; equation was, I believe, the term used.

Q. 81. Is the price a dollar and fifty-five cents per barrel of glycerine of fifteen degrees charged by you for concentrating glycerine an average estimate of the price charged?

A. My recollection is that it is the actual price for the whole time.

Q. 82. Then, if we divide the number of barrels sold by you, to wit, 65,312, by six and a half and multiply by one dollar and

1172 fifty-five cents the result, added to $103,143.03, received for the crude glycerine, will be the total sum of money received by you for glycerine during the period of accounting?

A. I should say not. The sum that is proposed to add was received for concentration; not received for glycerine.

Q. 83. How much of this one dollar and fifty-five cents was profit?

(Mr. PARKINSON: I object to it as irrelevant and incompetent.)

(The MASTER: The objection is overruled.)

(Mr. PARKINSON: The respondents excepts.)

A. I cannot state accurately. It must have varied during the time.

Q. 84. State as near as you can.

A. I cannot state it.

Q. 85. Was your profit as much as ten per cent.?

(Objection the same as before. Same ruling and exception.)

A. I have already stated that I could not state accurately. It may have been ten per cent.; it may have been more and may have been less.

Q. 86. In your opinion, would ten per cent. be a fair estimate of your profit, or do you think it would be more or less than that percentage—that is, ten per cent. on a dollar and fifty-five cents for each barrel of glycerine concentrated to fifteen degrees?

A. I do not wish to express an opinion, as I have no clear recollection upon the subject.

Q. 87. You must have some idea as to whether you made any profit out of the operation of concentrating the glycerine from three and a quarter degrees to fifteen degrees, have you not?

1173 (Objected to as before. Same ruling and exception.)

A. I have been endeavoring while this matter has been before us to recall the subject as fully as possible, and I have an idea that there was a profit, but how much or how little I cannot state.

Q. 88. Are there any books or papers in the possession of your firm which would show, or approximately show, the amount of this profit, if any?

A. I can examine, but I do not think there are.

Q. 89. Who of your firm has charge of this branch of the business?

A. During that period I had charge of it and probably made an estimate for this charge for concentration.

Q. 90. Will you examine your books for such data as may be in the possession of your firm, and when you have refreshed your memory as much as possible, estimate about what the profit, if any, was to your firm on the price charged for concentration?

(Same objection; same ruling; same exception.)

A. I will do so; it will require a little time to do it.

Q. 91. Can you state how many barrels of crude glycerine at three and a quarter degrees it takes to make a barrel of glycerine at twenty-five degrees Baumé?

A. I cannot from recollection.

Q. 92. Have you any data as to the ratio between crude and concentrated glycerine when the concentrated glycerine is either greater or lesser than fifteen degrees Baumé?

A. I have data showing the amount of twenty-five degrees, which would be produced by a given amount at three and a quarter; may have others, but I am not sure whether I have or have not.

Q. 93. Will you examine such data as you have and state what such ratios are when you have ascertained the fact.

1174 A. I will.

Q. 94. Has your sulphate of lime residue, after it has been thoroughly treated by you, ever been submitted to or examined by firms engaged in the business of extracting oils from foreign substances by means of the hydrocarbon process?

A. No.

Direct examination closed, reserving the right to examine and have the questions 90 and 93 answered.

Cross-examination by Mr. PARKINSON:

X Q. 95. What was the nature of the correspondence with Mitchell, referred to in answer to question 20, and did it take place with reference to the time when you stopped paying royalty?

A. It took place a considerable time prior to the time we stopped paying royalty; I had reference to the defense that was being made or could be made in regard to Mr. Tilghman's patent.

X Q. 96. Did it or did it not refer to your stopping payment?

A. It did not refer to our stopping payment.

X Q. 97. Can you state about how long before you stopped payment this correspondence took place?

A. No, I cannot state the time; simply my recollection is that it was not in connection with that, or at that time.

X Q. 98. Referring to your answer to question 57, when did you stop washing, when washing would, in the estimation of the operative, fail to pay by itself the expense of washing, or, if not, what has been the rule?

A. I stated in another answer—I do not remember the number—
1175 we continued to wash until little or no fat arises to the surface; we would not stop when the washing would not pay for that particular washing; we require the operative to go on until, as I said, little or no fat rises, in order to secure thorough and economical work.

By Mr. CHAMBERS:

X Q. 99. Do you know whether the addition of sand to the sulphate of lime while it is being washed effects any perceptible difference in the quantity of fatty acids obtained from it?

A. The addition of sand will make the reproduction of fatty acids more rapid or expeditious. Whether it will set free a larger quantity than might be otherwise obtained I cannot say positively.

TUESDAY, *April 4th*, 1882.

JAMES N. GAMBLE appears before the master and answers the questions heretofore reserved for answer, as follows:

Q. 90. Will you examine your books for such data as may be in possession of your firm, and when you have refreshed your memory as much as possible estimate about what the profit, if any, was to your firm on the price charged for concentration?

A. No part; that was our estimate of the cost.

Q. 93. Will you examine such data as you have, and state what such ratios are when you have ascertained the fact?

A. One barrel of 3 or $3\frac{1}{4}$° made $33\frac{53}{100}$ lbs. at 25°; $13\frac{73}{100}$ bbls. of $3\frac{9}{10}$ made 1 bbl. at 20°; 1,400 gal's at $3\frac{9}{10}$° made 294 gal's at 16°.

JAMES N. GAMBLE.

1176 Circuit Court of the United States, Southern District of Ohio
Equity.

RICHARD A. TILGHMAN, Complainant,
vs.
WILLIAM PROCTOR *et al.*, Respondents.

901 WALNUT STREET, PHILADELPHIA, *May* 31*st*, 1882.

Met pursuant to agreement of counsel.

Present: Francis T. Chambers, for complainant, and R. H. Parkinson, for respondents.

It is hereby stipulated and agreed between counsel that the testimony taken in Philadelphia at this time shall be taken and written down by Richard S. Child, Jr., notary public, all exceptions to be noted and reserved for the decision of the master.

ROBERT SHOEMAKER, being duly affirmed, deposes and says, in answer to questions propounded by Francis T. Chambers, as follows:

Q. 1. What is you name, age, residence, and occupation?

A. Robert Shoemaker; age, 66 years; residence, Cheltenham township, Pennsylvania; occupation, druggist in Philadelphia; my place of business, Fourth and Race streets.

1177 Q. 2. How long have you been engaged in the drug business?

A. I entered the business [in] 1837 and have been in it ever since.

Q. 3. Have you had occasion in your business to make and sell glycerine, and, if so, when did you first do so?

A. About 1846 I made the first glycerine, and first made in this country as far as I know.

Q. 4. Please state how you made this glycerine in 1846.

A. I was making at this time time lead plaster. In the manufacture of that plaster and the saponification of the lead and oil glycerine is eliminated by the process. Litharge, an oil or fat, and water were boiled together until the fat was saponified and an insoluble lead soap formed. The soap or plaster was dipped out and put into cold, fresh water, in which it was worked or kneaded until the plaster became white and the glycerine washed out. This glycerine water was then evaporated by steam jacket and pans until it was reduced to the consistence of a thin syrup. I then transferred it to glass vessels and passed through it sulphureted-hydrogen gas until all the lead held in solution was precipitated. I then continued the evoporation until proper density was obtained. The process was then finished by exposure to the rays of the sun for bleaching.

Q. 5. How long did you continue to manufacture glycerine in this way?

A. I ceased manufacturing 1st of January, 1850. I then sold out that part of my business to N. Spencer Thomas.

Q. 6. Did you sell glycerine after this date?

A. Yes; I took all he made for two or three years after and have continued selling up to the present time.

Q. 7. Please state the prices at which you sold glycerine during the time you were manufacturing it.

A. I sold at ($4) four dollars per pound first, and in looking over my books I find no charge of less than ($2.70) two dollars and seventy cents up to 1850.

1178 Q. 8. Please state, as nearly as you can, at what price you sold glycerine after you ceased to manufacture and prior to 1854.

A. As far as I have examined my books I found none sold for less than ($1.50) one dollar and fifty cents per pound.

Q. 9. To what class of consumers did you usually sell your glycerine?

A. To druggists and perfumers.

Q. 10. Were your sales confined to Philadelphia?

A. No, sir: I sold New York, Boston, Baltimore, New Orleans, Louisville, Ky., and, perhaps, other places.

Q. 11. To whom in Philadelphia did you sell the largest quantity of glycerine?

A. Perhaps to Powers & Weightman, manufacturing chemists.

Q. 12. The process used by you produced both lead plaster and glycerine; were these both valuable and salable articles?

A. They were; when I first commenced to manufacture glycerine the lead plaster was the most valuable of the two; afterwards the glycerine became the most valuable, and the plaster became a refuse material.

Q. 13. When did this process for making glycerine cease to be used?

A. I cannot answer that question. I can only tell when I ceased using it and when Spencer Thomas ceased using it. I knew of no others that ever did use it.

Q. 14. When and why, if you know, did Mr. Spencer Thomas cease the use of this process for the manufacture of glycerine?

A. I should think about 1856 or 1857 he ceased using it because an article was offered at a less price than it could be made for by this process and, perhaps, of better quality—heavier—entirely free from lead. Price's English Glycerine was then being sold in this country and, I think, it was about this time that Gordon, of Cincinnati, commenced to sell glycerine.

Q. 15. Do you recollect what was the density of the glycerine which you and Mr. Thomas manufactured?

A. I do not.

1179 Cross-examination:

X Q. 16. How long had you been manufacturing the lead plaster

of which you speak before you began saving the glycerine in 1846?

A. From 1837 to 1846—nine years.

X Q. 17. You manfactured it in the same way before as after you began to save the glycerine?

A. Yes.

X Q. 18. Now, just what steps were added to the process of manufacture for the purpose of saving and concentrating the glycerine?

A. Well, that the water in which the plaster is washed and cooled was transferred to an evaporating pan, and the evaporation was continued until the liquid was reduced to about the consistence of a thin syrup. It was then transferred to glass vessels and sulphureted-hydrogen gas was then passed through the liquid for the purpose of precipitating the lead held in solution. It was then filtered and the precipitate thrown away; after further evaporation and bleaching in the sun, ready for sale.

X Q. 19. Please state as accurately as you can the items of expense involved in the process described in your last answer, especially that connected with the precipitation by sulphureted hydrogen.

A. The expense of the gas, sulphureted hydrogen, is small. I can tell the cost of glycerine. It would be impossible to tell the cost of each step.

X Q. 20. Please state as definitely as possible the expense of the treatment with sulphureted hydrogen for the purpose of precipitation.

A. I could not estimate the cost at all.

X Q. 21. Can you not state it approximately?

A. I do not think I can state the cost of the different steps in the process of manufacture of any article. I can give approximately the total cost of production. My memoranda showing the cost of each item were burnt up in 1857 or 1858.

1180 X Q. 22. Can you state the quantity of sulphureted hydrogen used for a particular amount of glycerine or give me any other data by which the expense attending the precipitation can be calculated?

A. I cannot.

X Q. 23. Prior to 1846 you had allowed this glycerine to go to waste?

A. I had.

X Q. 24. About what quantity did you sell in each of the years from 1846 to 1850?

A. I went over the years some time ago in preparing an article for the American Journal of Pharmacy, and by permission I will refresh my memory. In 1848, fifteen pounds; in 1849, two hundred pounds. In 1850 I sold much more than two hundred pounds. I cannot tell the quantity. The consumption increased steadily as long as I continued the sale.

X Q. 25. You have spoken of selling this glycerine at prices ranging from $4.00 to $1.50 per pound. How much less did it cost to manufacture that sold at $1.50 than that sold at $4.00?

A. I did not manufacture that sold at $1.50. It cost Mr. Thomas less, I presume, to manufacture that which was sold at $1.50 than it

did me prior to 1850, because he was manufacturing on a much larger scale. That I sold at $4.00 cost me no more, probably, than that I sold at $2.70.

X Q. 26. The price at which druggists sell articles which are retailed in small quantities is not generally a very accurate indication of the actual cost of such articles?

A. No.

X Q. 27. What was the minimum price you paid Mr. Spencer Thomas for the glycerine which he furnished you prior to 1854?

A. So far as I have examined, $1.50 per pound.

X Q. 28. Then did you sell this at the same price you bought it?

A. I don't remember I sold any as low as $1.50. I sold — $1.63 in 1851. I found one entry. I think there must have been a discount of ten per cent. on the $1.50 sold by Mr. Thomas. The
1181 entry of $1.50 is the lowest I find I ever paid Mr. Thomas, and was about the time he stopped manufacturing. My sale of the manufacturing portion of my business to Spencer Thomas was made without a cash payment and under an agreement that I should receive all goods from him at ten per cent. less than his regular selling price. No doubt the entry of $1.50 was subject to this discount, and this discount continued until the factory was paid for, the payment being in goods manufactured by Thomas.

X Q. 30. You have stated that you could estimate the cost of manufacturing this glycerine. Please state your estimate as the process was carried on from 1846 to 1850, indicating as definitely as you can how your estimate is made up.

A. As near as I can remember we considered the cost of glycerine $2 per pound and it was made up of the original cost of the materials, the lead and the oil, fuel and labor.

X Q. 31. Excluding the cost of the oil and of all steps that precede it—that of which you began to treat the glycerine which had been before allowed to go to waste—what was the cost of the remaining steps and in what proportion do you charge them in your estimate to each particular step?

A. I suppose not more than 10 per cent. would be credited to the plaster. That would leave the cost of glycerine $1.80. I can't give cost of each step.

X Q. 32. In what quantities did you usually manufacture the glycerine?

A. As near as I can remember about 2 gallons of finished glycerine, about 24 lbs. I think the largest sale I made while manufacturing was 15 lbs., which I sold at $3 per pound and considered a very large sale. It was so much larger than any other I made it made an impression on my mind.

X Q. 33. What was about the usual size of your sales while you were manufacturing?

A. From 2 to 5 lbs.

X Q. 34. Do you know what druggists usually sell glycerine now when sold in quantities of from 2 to 5 lbs.?

1182 A. Wholesale druggists sell to retailers in those quantities for medicinal purposes. Our price —, I think, about 40 cents,

and about 60 cents for chemical[ly] pure. I have bought as low as 14 cents within two or three years. I have been informed recently that retail druggists sell small quantities for 10 cents an ounce..

X Q. 35 Can you state about what proportion of your estimated cost of the manufacture of glycerine is chargeable to labor?

A. Well, I should think one-half. I don't know; that is I guess; this evaporation, as of long continuance, keeps a man stirring from morning to night for a couple of days.

X Q. 36. Can you state about what proportion is chargeable to fuel?

A. No; I cannot.

X Q. 37. The cost of producing glycerine by that process would be very considerably reduced if it were carried on upon an extensive scale and with such mechanical conveniences as would naturally be employed in a large manufacture?

A. Yes; if the stirring could be done by machinery and exhaust steam used by the evaporation.

X Q. 38. When did the imported glycerine first come into competition with you?

A. I suppose in 1853 or 1854.

X Q. 39. I find in your article in vol. 51, American Journal of Pharmacy, to which you have referred to refresh your memory, the statement, after referring to your sales up to 1850, as follows: "Glycerine now began to be imported from England (Price's) and sold at a price below what it cost me to produce it, so I gradually ceased to make it." Is this statement correct; and, if so, how does it happen that you there speak of glycerine as imported about 1850 and assigned that as a reson why you gradually ceased to make it, when you now state that you ceased to make it several years before it began to be imported?

A. I do not state in my article that it was imported in 1850.

1183 I wrote the article as a man would write for a newspaper—for general information—not being particular as to dates; it is correct in the main; I could not tell you now what year I first saw Price's glycerine.

X Q. 40. Your article above referred to was written not later than June, 1879, and contained the following language, did it not? "Looking back over my books I find the first entry charging glycerine under date of '6 mo., 1st, 1848,' and this was to Edward Parrish, then at the northwest corner of Chestnut and Ninth streets. The quantity was small, only ¼ lb., and the price charged was $4.00 per lb. The next sale was to a New York house, at same price and for a larger quantity. The entire product sold in 1848 was about 15 lbs. In 1849 I reduced the price *in* $3.00 per lb., and it remained steadily at this figure until near the close of 1850, when it fell to $2.75. The quantity sold in 1849 was about 200 lbs. The demand rapidly increased, and in 1850 the quantity sold was much larger, and I find no charge at a less price than $2.70 per lb. I find sales entered to druggists (besides those in this city) in New York, Boston, Providence, Baltimore, Louisville, New Orleans, etc. The greatest demand, however, came from our own wholesale houses, the manufacturing

chemists being the largest buyers. Glycerine now began to be imported from England (Price's), and sold at a price below what it cost me to produce it, and so I gradually ceased to make it. This English article was made from 'soap liquor.'"

A. Yes.

X Q. 41. Have you any means of fixing the date when other glycerines came in competition with yours other than general recollection?

A. I have entries of sales made up as late as 1852; I think up to 1854, perhaps. I have not looked at my books later than 1851 recently.

X Q. 42. Who suggested to you this saving of your glycerine, [in] 1846?

A. Prof. Proctor suggested it. We had talked it over in the laboratory before that time.

1184 X Q. 43. What uses was glycerine put to in those years, from 1846 to 1850?

A. All for medical purposes.

X Q. 44. Have any new uses sprung up since that time? If so, could you name some of them?

(Objected to, as the witness is not produced as an expert in the uses of glycerine.)

A. I only know by common report that it is used for manufacture of explosive compounds, beer, and perfumers use it largely.

X Q. 45. A very small proportion of what is sold to-day is used for medical purposes?

A. Yes; I presume so.

Mr. Chambers offers in evidence the article from the American Journal of Pharmacy referred to in the above examination, the same being in vol. 51, pp. 289 to 291.

(To which exhibit counsel for defendant objects as incompetent and irrelevant, except so far as it may be explanatory of the quotations made therefrom.)

ROBERT SHOEMAKER.

Sworn and subscribed to before me this 31st day of May, A. D. 1882.

R. S. CHILD, JR.,
Notary Public.

RICHARD A. TILGHMAN, being sworn, deposes and says in answer to questions propounded by FRANCIS T. CHAMBERS as follows:

Q. 1. What is your name, age, residence, and occupation?

1185 A. Richard A. Tilghman; aged fifty-eight; Philadelphia, Pennsylvania; chemist. I am the complainant in this suit.

Q. 2. Please state whether you have recently made any fatty acids by means of the process known in this suit as the old lime-saponification process.

A. I have.

Q. 3. Please state the steps of the process as used by you.

A. The fat was boiled with 14 per cent. of lime by a jet of open steam with about the same quantity of water as the fat, the boiling being as violent as compatible with avoiding the escape of the charge from the barrel, and continued for over six hours. Next day, after removing the glycerine and water from the lime soap produced, a large excess of diluted sulphuric acid was added and violently boiled with the lime soap for four hours. The fat acids were then allowed to solidify by cooling into a solid mass.

Q. 4. There was a deposit of sulphate of lime in the tub in which you treated the lime soap with acid, was there not?

A. There was a very large deposit of sulphate of lime.

Q. 5. Did this sulphate of lime deposit contain fatty acids mixed with it?

A. It did.

Q. 6. Please state whether you made any efforts to separate the fatty acids mixed with the sulphate of lime deposit from the sulphate of lime, and, if so, describe in detail what methods for effecting this separation were used by you, and what the effects of the different means of separation were.

A. The first attempt was by violent boiling with open steam after the addition of a considerable quantity of fresh water; after about half an hour's boil the steam was cut off and the mass allowed to settle and a certain amount of fatty acid which had risen to the surface was carefully skimmed of. This boiling and skimming was repeated four times in all, with continued liberation of fatty acids,
1186 but in rapidly diminishing proportions with each successive boil, so that at the last boil it did not seem to be worth while to continue that mode of extraction any further. It was then desired to imitate as nearly as possible the mode described by evidence in this case as being in use at the factory of the defendants by the addition of sand. This sand I possessed only to the extent of a small sample taken at defendants' works, which was found by a rough examination to consist of about one-third carbonate of lime and the remainder common sand. An artificial mixture of carbonate of lime and common sand was tried on a small sample of sulphate of lime and its efficiency found to depend, as might have been expected, entirely on the carbonate of lime contained in it, the sand being really a useless diluent. The liberation of fatty acids appeared to be produced entirely by the effervescence of carbonic-acid gas expelled from the carbonate of lime in the sand by the excess of sulphuric acid in the water accompanying the sulphate of lime. The carbonate of lime being mixed among the fine crystals of sulphate of lime, and there giving off its gas, had an effect of liberating a portion of the fat acid adhering to the sulphate of lime more perfectly than the latter boilings had done. Successive additions of carbonate of lime continued to give successive yields of fatty acids, but with steadily-declining quantity. Although repeated ten or fifteen times, in some instances a film of fatty acid could always be detected on the surface of the water. After having carried the process many times further than I believed it

would be practicable, or rather profitable, to do on a manufacturing scale, I then tried whether by the action of solvents a larger production of fatty acids could be obtained than by the effervescent plan. A portion of this same sulphate of lime which had undergone the boiling and effervescent treatment was gently dried and then boiled with an excess of alcohol of ninety-six per cent., with frequent stirring. Three such extractions were made with successive doses of alcohol, and the filtered solution evaporated
1187 to dryness gave a yield of fatty acids apparently much greater than had been obtained by several of the last preceding effervescences combined. To see whether the sulphate of lime was even then totally stripped of its fatty acids a long-continued boil with alcohol was repeated. The alcohol was allowed to stand upon it all night, reboiled in the morning, filtered and evaporated, with again the production of fatty acids, which might perhaps yield, by the estimate of bulk, about a third of the preceding alcoholic evaporation. Inasmuch as the whole of the fatty acids thus obtained by the alcohol could have been dissolved by a minute portion of the alcohol actually employed for the purpose, I consider this as proof that the fatty acid is not merely an adhered film on the surface of the crystals of sulphate of lime, but must be diffused through their entire substance.

Adjourned until 11 a. m. Thursday, June 1st.

Cross-examination.

JUNE 1ST, 1882.

Met pursuant to adjournment.

Present: Counsel as before.

Cross-examination of R. A. TILGHMAN by Mr. PARKINSON:

X Q. 7. State about the quantity of fat treated in the experiments you have described and what kind of fat it was.

A. Fifty pounds of tallow were used in each of the saponification experiments.

X Q. 8. Is six hours about the usual time of boiling in the old saponification process as usually carried on in manufactories?

A. No definite time has been agreed upon by manufact-
1188 urers in general, and they vary from six, eight, and ten hours, depending chiefly upon the violence of the ebullition which they were able to give the charge, having a great excess of steam at command. I gave as active a boil as was compatible with retaining the charge in the barrel; the perfection of the saponification was tested by the examination of the fat acids produced.

R. A. TILGHMAN.

Sworn and subscribed before me this 1st day of June, A. D. 1882.

R. S. CHILD, JR.,
Notary Public.

CHARLES BULLOCK, affirmed according to law, deposes and says, in answer to interrogatories by Mr. CHAMBERS:

Q. 1. What is your name, age, residence, and occupation?

A. Charles Bullock; age, 56; reside in Philadelphia; my business is a chemist and druggist, of the firm of Bullock & Crenshaw.

Q. 2. How long have you been in this business?

A. I have been in the business since January 1st, 1849.

Q. 3. Did you have occasion to buy and sell glycerine prior to 1854; and, if so, in what year?

A. I did, beginning in 1849, and have sold it up to the present time.

Q. 4. Have you any books which will show the quantity of glycerine purchased by you prior to 1854 and the prices you paid for it?

(Mr. Parkinson objects to this as irrelevant.)

A. I have. I produce a book called our purchase-book, in which we entered the cost price of materials purchased.

1189 It is hereby agreed and stipulated by counsel that the portion of the book which the witnesses produces, which is pointed out by him as relating to glycerine, shall be copied on the record at the end of his deposition, and that the said copy shall be considered, for the purposes of this case, as if it were the original, Mr. Parkinson reserving his objection as to relevancy.

Mr. Chambers offers in evidence the portion of the book designated by the witness, the same being marked "Complainant's Exhibit Bullock & Crenshaw's Purchase-Book."

Q. 5. Will you please explain the meaning of the entries in the "Exhibit Purchase-Book" produced by you?

A. The first entry is in May, 1849, and shows a purchase from R. Shoemaker of 4 lbs. of glycerine at $3.00 per pound. The entries show purchases from Mr. Shoemaker and Mr. Thomas at same price until May 15th, 1850; after this the price is $2.50 up to September, 1850; after this the price is $2.00 up to September, 1851, when the price fell to $1.50 and continued at that price up to June, 1852, the date of the last entry in the book produced by me. Our purchase-book showing purchases of glycerine subsequent to the last date given has been lost.

Cross-examination:

X Q. 6. Can you state what the price of glycerine in 1852 and 1853 was?

A. I would not like to trust to my memory.

X Q. 7. You have stated off the record about the date when English competition began to reduce prices; will you please repeat that remark on the record?

A. I believe that all I said was "after this," not giving any time.

X Q. 8. Did you not state that in 1852 and 1853 the English competition was cutting down rates?

1190 A. I have no recollection of stating the particular years.

X Q. 9. Please endeavor to refresh your recollection and

state positively, if you can, whether or not you made this remark during your direct examination, and after making it had some consultation with Mr. Tilghman about these dates.

A. I think I have a very distinct recollection as to what I said. I did not make the remark as to particular dates, but heard Mr. Tilghman state the time of introduction of English glycerine.

X Q. 10. You will state positively, will you, that you have not, since you came into this room to-day, stated that English competition begin to cut rates in 1852 and 1853?

(Objected to as already repeatedly answered by the witness and as immaterial.)

A. I have no recollection of mentioning any date, saying subsequent to 1852.

X Q. 11. Please state your own recollection as to when English competition began to cut rates on glycerine.

A. Thirty years ago is a long time to recollect, and without having the books, which, as I have said, are lost, I cannot state the date.

X Q. 12. How did the price of alcohol, from 1849 to 1852, compare with the present price?

A. From 40c. to 45c. per gallon, in 1849 to 1852, to $2.00 to $2.25 per gallon to-day.

CHAS. BULLOCK.

Sworn and subscribed this 1st day June, A. D. 1882.

R. S. CHILD, JR.,
Notary Public.

1191 "COMPLAINANT'S EXHIBIT" BULLOCK & CRENSHAW PURCHASE-BOOK. R. S. C., Jr., N. P., June 1, 1882.

Glycerine,	5. 23. 49. R. Shoemaker, ½ lb., $3.00.	6. 1. 49. do. 1 lb., $3.00.
	6. 27. 49. do. 1 lb., $3.00.	8. 29. 49. do. 1 lb., $3.00.
	1. 18. 50. Thomas. ½ lb., 3.00.	1. 24. 50. R. Shoemaker. 1 lb., 3.00.
	2. 6. 50. S. Thomas. 1 lb., 3.00.	2. 14. 50. do. 1 lb., 3.
	2. 26. 50. do. 5. 3.	3. 7. 50. do. 2 lb., 3.

	3. 7. 50. do. 4 lb., 3.00.	3. 8. 50. do. 4 lb., 3.00.
	5. 15. 50. do. 3 lb., 2.50.	8. 18. 50. N. S. T. 2 lb., 2.50.
1192	9. 21. 50. N. S. T. 2 lb., 2.50.	10. 5. 50. N. S. T. 5 lb., 2.00.
	12. 30. 51. N. S. T. 2 lb., 2.00.	1. 18. 51. N. S. T. 4 lb., 2.00.
	3. 27. 51. N. S. T. 10 lb., 2.00.	9. 5. 51. do. 4 lb., 1.50.
	9. 5. 51. N. S. T. 4 lb., 1.50.	12. 8. 51. do. 4¾ 1.50.
	2. 12. 52. do. 9½. 1.50.	6. 11. 52. do. 10 lb., 1.50.

BENJAMIN C. TILGHMAN, being duly sworn, deposes and says, in answer to questions by Mr. CHAMBERS:

Q. 1. What is your name, age, residence, and occupation?

A. Benjamin C. Tilghman; I am sixty years of age; I reside in Philadelphia; I am an experimental chemist.

Q. 2. Please state what is your relationship with the complainant in this suit, and whether or not you were associated with him in the introduction of his invention into practical use.

A. I am the brother of the complainant and was his agent in relation to the patent now in suit and the introduction of the invention into practical use, and am interested in the result of this suit.

Q. 3. Did you personally aid in the introduction of the invention into Cincinnati?

1193 A. I did, in December, 1859. I took on to Cincinnati an apparatus and had it put up at the factory of N. Ropes & Co.

Q. 4. Please state whether you made any comparative tests as to the production of fatty acids by Mr. R. A. Tilghman's process and by the old lime-saponification process.

A. A test was made by Mr. N. Ropes, Jr., the manager of the factory, toward the end of the month of January, 1860, upon about two thousand (2,000) pounds of lard stearine, one thousand (1,000) pounds of water, and ten (10) pounds of lime, which were heated

and mixed together in a close vessel at a pressure of about 150 pounds to the square inch. The fatty matter was then separated from the glycerine water and thrown into a tub, where it was boiled with sulphuric acid to extract the lime. The free fat acid was then run off into pans and cooled. Every care was taken in the first place to have the vessels entirely clean and free from any other fatty matter, and in the second place to collect accurately all the scums and bottoms of this particular lot of fat and to remelt them and get them free from water. The whole product was then carefully weighed by Mr. N. Ropes, Jr., in my presence. The result of the fat was that there was 97 pounds of fat acid obtained from every 100 pounds originally put in.

Q. 5. Had you prior to this time, either by yourself or in connection with Mr. R. A. Tilghman, made any experiments to ascertain what the yield of fatty acids was from fats treated by the Tilghman process?

We had made such trials on a small scale in our laboratory and had obtained results about the same or a trifle higher. In that case we were able to wash the vessels with alcohol and extract every trace of adherent fatty matter more perfectly than could be done on a manufacturing scale.

Q. 6. Please state how the experiment of which you have spoken made at Ropes' factory came to be made.

A. We had put up the apparatus for Mr. Ropes at our
1194 own expense and risk, with the agreement that after a certain time of trial he should have the option to purchase the apparatus at a fixed price and take a license at a fixed royalty, or that we would take the apparatus away at our own expense. It was therefore important for him to know both the cost of the process as compared with the one he was then using and also its yield in fat acid as compared with the yield of the old process. It was to ascertain this last point that the experiment was tried.

Q. 7. How did this yield of 97 per cent. of fatty acids compare with the yield which manufacturers were getting by the use of the old process?

A. It was two (2) per cent. higher than they had been in the habit of obtaining by the old process.

Q. 8. You have stated that in this experiment, made at Ropes' factory, ten pounds or one-half ($\frac{1}{2}$) per cent. of lime was used. After this lime had been precipitated from the fatty acids, as sulphate of lime, did you or Mr. Ropes treat it for the recovery of any adhering or contained fatty acids?

A. The quantity of sulphate of lime precipitated was very small; a portion of the lime is taken up and remains in the glycerine water. The quantity of water and sulphuric acid necessary to boil the fat acid and lime is considerable, probably not less than half the bulk of the fat; the consequence is that a considerable portion of the sulphate of lime remains dissolved in the hot acid water. The portion that precipitates is a very light crystalline matter, and was so small in quantity that it was neglected and was not washed or treated to separate any grease from it.

Cross-examined by Mr. PARKINSON:

X Q. 9. Did you acquire the interest you have in any recovery that may be made in this suit before or after the commencement of the suit?

(Objected to as irrelevant and immaterial.)

A. Before.

1195 X Q. 10. Have you and have you had since a time prior to the commencement of this suit an interest in all recoveries and license fees under the patent in suit, or simply an interest in the recovery of this particular suit?

(Same objection.)

A. I have had an interest in all recoveries and license fees since a time prior to the commencement of this suit—since 1854.

B. C. TILGHMAN.

Sworn and subscribed this 1st day of June, A. D. 1882.

[SEAL.] R. S. CHILD, JR.,
Notary Public.

Mr. Chambers offers in evidence the lecture of George F. Wilson "on a new process of obtaining and purifying glycerine," on pages 729 to 731 of the Journal of the Society of Arts, vol. 3, said lecture having already been put in evidence in this case and a portion of it printed on pages 105, 106, and 107 of the Supreme Court record.

Also the article on pages 247 and 248 of vol. 24, Comptes Rendas De L' Academie des Sciences, same bearing date from January to June, 1847, said article being entitled "Chemie.—Sur plusieurs composés detonauts produits avec l'acide nitrique et le sucre, la dextrine, la lactine, la mannite et la glycérine; par M. Oscogne Sobrero (Extrait d'une Lettre à M. Pelouzé)."

(Counsel for respondents objects to the several above-named exhibits as irrelevant and incompetent and without waiving said objection.)

1196 It is stipulated by counsel that copies of the articles offered in evidence shall be made and marked as exhibits, the same to be considered in all respects as if they were the original.

It is also further stipulated that a translation from the article in the Comptes Rendas, which has been prepared by Mr. B. C. Tilghman, shall be printed in the record and be considered *prima facie* to be correct—defendants reserving the right to contest the accuracy of the translation if they find it desirable.

Complainant's counsel gives notice that in the presentation of this case, on accounting before the master, he will refer to the testimony taken in the case before the final decree, and which is contained in the Supreme Court record, and without waiving his right to refer to any [or] all such testimony, he, for the purpose of facilitating the examination of the bulky record, calls the attention of respondents' coun-

sel to the depositions of the following witnesses as containing matter considered of especial relevancy to this accounting:

James Gamble, record, page 515.
C. T. Jones, page 32.
J. T. Verdin, page 138.
F. Verdin, page 349.
Michael Werk, page 432.
F. Verdin, page 157.
C. H. Grant, page 931.
H. Bower, page 229.
N. Ropes, Jr., page 498.
C. H. Grant, page 371.
N. Ropes, Sr., page 503.
N. Ropes, Jr., page 524.

1197 JAMES N. GAMBLE recalled and examined by Mr. CHAMBERS:

Q. Please examine your answer to question No. 93, and state under what circumstances the experiments you speak of there were made and what your knowledge and belief is as to their accuracy and reliability.

A. In my answer there are three statements. By a re-examination with the data I have I find that the first and third are the results of experiments of which I have the details, and believe them to be accurate. The second I find to be a memorandum without details, and I have doubt as to its accuracy.

JAMES N. GAMBLE.

Sworn and subscribed the 1st day of June, A. D. 1882.
[SEAL.] R. S. CHILD, JR.,
Notary Public.

Complainant's *prima-facie* case closed.

STATE OF PENNSYLVANIA, *City and County of Philadelphia:*

At Philadelphia, in said county, upon the 31st day of May and the 1st day of June, before me, a notary public for the Commonwealth of Pennsylvania, residing in the city of Philadelphia, personally appeared Robert Shoemaker, Richard A. Tilghman, Charles Bullock, Benjamin C. Tilghman, and James N. Gamble, who made oath and affirmation to their deposition by them subscribed that the same contained the truth, the whole truth, and nothing but the truth, which oath was administered by me before the commencement of their testimony.

The said testimony was written out in their presence at N. W. corner of Ninth and Walnut streets, Philadelphia, at the office of George Harding, Esq., upon the said days. The said depositions were taken at the request of Richard A. Tilghman at the time and place named, to be used upon the hearing on account before the master in the within-entitled case.

1198

The said William Proctor *et al.* were duly notified and attended by their counsel, R. H. Parkinson, Esq.

Witness my hand and official seal this first day of June, A. D. 1882.

[SEAL.] R. S. CHILD, JR.,
Notary Public.

1199 United States Circuit Court for the Southern District of Ohio. Equity.

R. A. TILGHMAN, Complainant,
vs.
PROCTER & GAMBLE *et al.*, Respondents.

Hearing before Channing Richards, Esq., master.

MAY 14*th*, 1883.

Appearances: F. T. Chambers, for complainant; R. H. Parkinson, for defendants.

HERMAN ENDEMANN, being duly sworn on behalf of the defendants, was examined by Mr. PARKINSON, and testified as follows:

Q. 1. Please state your name, age, residence, and occupation.

A. Herman Endemann; my place of business is in New York city; my residence is in Brooklyn; I am a chemist by profession; my age is forty-one years.

Q. 2. What opportunities, if any, have you had of becoming familiar with the sciences, and especially chemical science, and with the practical applications of the same?

A. I studied chemistry two years and a half at the Polytechnic in Hesse-Cassel; then I went to the University of Giessen, studied
1200 there one year—studied chemistry; afterward I went for three years to the University of Marburg; in 1864 I took my degree as Doctor in Philosophy and obtained an appointment as assistant professor at the Polytechnic at Stuttgart. I stayed there three years and came then to the United States. I was at first assistant of Professor Chandler, at the School of Mines, Columbia College.

Q. State, in that connection, where that is.

A. In New York city; then I became connected with the health department of the city of New York and stayed with the health department for twelve years; during that time have been frequently expert in patent cases. Since about 1881 I severed my connection with the health department and am now conducting a laboratory for investigations at No. 33 Nassau street, New York.

Q. 4. In what class of questions has your work as an expert mainly been—chemical or mechanical?

A. Always chemical.

Q. 5. What familiarity have you with the German and English languages?

A. I am a German by birth, and I learned the English language while I was in this country—the last sixteen years.

Q. 6. State whether or not you read and speak both readily?

A. I do.

Q. 7. Have you read the complainant's patent in this cause?

A. I have.

Q. 8. And do you understand the same?

A. I think I understand the same.

Q. 9. Have you read the record—the transcript of record—in this cause?

A. I have read what I considered the most important portions of it.

Q. 10. The most important part in what respect?

A. In a chemical sense.

1201 Q. 11. Have you read the depositions relating to chemical questions so far as you have in going over this record found such depositions?

A. I believe I have—the majority.

Q. 12. Have you read and do you understand Exhibits No. 4, page 247, and Exhibit No. 10, page 251, of the Supreme Court transcript.

A. I have.

Q. 13. Have you ever worked the process described and claimed in complainant's patent?

A. I worked this process, especially the one described in Exhibit No. 4, on page 247.

Q. 14. You did not quite understand my question, which was whether you had ever worked the process described and claimed in complainant's patent?

A. I have.

Q. 15. State whether or not the work of this Tilghman process was carried on by you upon a laboratory scale or upon a manufacturing scale, or both?

A. It has been carried out by me on a laboratory and also upon a manufacturing scale.

Q. 16. Describe the experiments or tests, state what material you used, what degrees of heat and pressure, what time, and what results were obtained.

A. On or about the 30th of March, I am not quite positive as to date, I made, in the presence of Professor Morton, experiments treating the materials under heat and pressure. The necessary motion for mixing the material was produced by a mechanical stirrer. The experiment was made at about 165 degrees centigrade, which is equal to about 90 pounds of pressure. The amount of fat and water were in equal proportions, and the operation was continued for six hours. At the end of these six hours the apparatus was allowed to cool, the fatty acid mixture was taken out, and the amount of fatty acid and neutral fat was determined therein by mechanical

1202 analysis. I found that the mixture contained 61.83-100ths per cent. of free fat acids and about 38.17-100ths per cent. of undecomposed fat.

A similar experiment on a manufacturing scale was made here in Cincinnati on the 10th of May, 1883, at the works of the defendants; the pressure use averaged about 150 pounds, as indicated by

the pressure guage directly connected with the tank. After running the operation for about nine hours a sample was drawn, and this sample was examined by me, with the following result: I found therein 76.47-100ths per cent. free acid and the rest undecomposed fat. The operation was continued for nine hours more, and at the end of that time it was discontinued completely on account of the apparatus giving away. The amount of fatty acids contained in the fat which was taken from the tank was 84.43 100ths per cent. of free acid. I took special precautions to inspect the apparatus, as soon as sufficiently cool, to see whether it had the construction of another apparatus which was used for a similar experiment, and found it to be the same. The stirring device in this second experiment which I have just mentioned was different from the stirring device which we have been using in the laboratory of Professor Morton, but it was just the same as the defendants use in their works, and which has been described.

The third experiment was made on a manufacturing scale in the apparatus which has been described by Mr. Tilghman in his specification for his patent. The apparatus was inclosed in brick work. I have no personal knowledge as to its interior construction, but what I saw of it seemed to correspond fully with the description given of the apparatus by Mr. Tilghman in the specification for his patent. The apparatus was heated up slowly to the required temperature, the heating commencing the night previous, when I took notice of smoke coming out of the chimney about two o'clock in the morning, when they started the fire, and the
1203 heating continued over twelve hours before the experiment was commenced. There was a pressure-gauge at the end of the apparatus, which was kept at a pressure of about two thousand pounds, as far as it was practicable, but it varied. At various stages of the process the temperature of the fluid, as it escaped from the outlet, would vary, but it was kept below 212 degrees Fahrenheit, and as near as possible to that described in the patent. The quantity of fluid which was pumped through the apparatus in a certain time was carefully gauged by others, and, as I believe and think that there will be testimony of other parties to that effect, it will be unnecessary for me to go into it. When the apparatus appeared to be in working order, which happened to be at 3.13 p. m., the mixture of fat, or emulsion of fat and water, was pumped into the apparatus, and was due at the other end of the apparatus at about 3.23 p. m., provided it had been allowed to stay in the coil ten minutes, as the patent states; but it did not come until 3.26 on account of the cooler, which had to be taken into account, and the passage through, which consumed about three minutes more. The quantity of material pumped through the apparatus was from time to time gauged by the engineer, who was specially there for the purpose of seeing that the apparatus worked in the proper way. The first sample I took was at 3 27 p. m.; at that time the tin was melting in the cavity of the apparatus; the pressure was 2,100 pounds. The sample which I took at this time contained 52.3-10ths per cent. of free acid.

The second sample was taken at 3.32 p. m., when the bismuth was barely melting; the pressure 2,000 pounds, the temperature at the outlet 178 degrees Fahrenheit.

The third sample was taken at 3.37 p. m.; the bismuth was now fully melted, the pressure, as shown on the pressure-gauge,
1204 1,600 pounds, the thermometer 188 degrees Fahrenheit, and the fatty substance obtained from it contained 45.5-10ths per cent. of free acid.

The fourth sample was taken at 3.42 p. m.; the pressure was then 1,400 pounds and the temperature 191 degrees Fahrenheit.

The fifth sample at 3.47 p. m; the pressure was then 1,950 pounds, and the temperature 162 degrees Fahrenheit.

The sixth sample was taken at 3.57 p. m.; the temperature of the apparatus had cooled down, the bismuth became solid, and only the tin was melted; the pressure, as shown by the guage at the end of the apparatus, was 2,000 pounds, the temperature 162 degrees Fahrenheit; the fatty acids, or fat given off by the apparatus, contained 51.6–10ths per cent. free acids.

The seventh sample was taken at 4.01 p. m.; the pressure was 1,650 pounds, the temperature 165 degrees Fahrenheit.

The eighth sample was taken at 4.26 p. m.; the pressure was 2,000 pounds, temperature 168 degrees Fahrenheit; the lead commenced to melt at this stage of the proceedings, and the fatty acids contained in the mixture then taken were 81.25-100ths per cent.

The ninth sample was taken and the lead was completely melted at 4.35 p. m., and was taken while the guage showed a pressure of 1,900 pounds, and the thermometer a temperature of 179 degrees Fahrenheit.

The tenth sample was taken at 4.45 p. m.; the pressure 1,400 pounds, temperature 149 degrees Fahrenheit; the sample then taken contained 78 per cent. free acid. When this sample was taken the lead was melted.

The eleventh sample was taken at 4.55 p. m., while the gauge showed a pressure of 2,100 pounds, and the fluid running out at a temperature of 118 degrees Fahrenheit; it contained 79.1-10th per cent. acids. The apparatus then gave way.

1205 I give these figures, with a certain reservation. So far as the quantity of free acid is concerned there might be a slight difference developed if we had to go over these and make these analyses under more favorable circumstances; but I do not think that the mistakes made in the analysis would be greater than one per cent.

Q. 17. When you speak of unfavorable circumstances affecting your analysis, do you refer to the circumstances attending the operation of this apparatus, or simply to the circumstances under which the analysis of the products were made?

A. The circumstances under which the analyses of the products were made. They were made in a chemical laboratory in this city, but the preparations were not so complete as I would like to have had them.

Q. 18. Were they as favorable as you were able to obtain, or would

they or would they not compare favorably with circumstances under which chemical tests are ordinarily made?

A. The arrangements were sufficiently favorable to get results which demand a certain accuracy; yet the accuracy would not be so great as I would obtain under more favorable circumstances at home, but the difference between the results which were obtained and the different results which might be obtained, if I went over the results, would be very small.

Q. 19. You have spoken of experiments made in a laboratory with President Morton; whose laboratory were they made in, and where?

A. In Professor Morton's laboratory, in Hoboken, New Jersey.

Q. 20. How were the circumstances there, favorable or unfavorable?

A. The analysis I made at home in my own laboratory; I
1206 only made experimets in this, and the analyses I did not complete; I took the samples along to my own laboratory.

Q. 21. How were the circumstances under which you made those analyses, favorable or unfavorable?

A. I think they were favorable.

Q. 22. In the experiments themselves, both in the laboratory and in the manufactory, state whether or not you endeavored to make all the conditions as favorable to a fair and full test as possible?

A. That has always been my desire, and I believe I have done so.

Q 23. When you speak of the temperature in connection with the test made with this coil apparatus, on a working scale, to what temperature do you refer by the degrees of Fahrenheit given, the temperature to which the material was raised in its passage through the coil or the temperature at which it came from the cooler?

A. The temperature at which it came from the cooler.

Q. 24. By what was the temperature in the heated coil indicated?

A. By the melting of metals which were contained in the several cavities of the coil.

Q. 25. You speak of the apparatus as having given out; in what way did it give out?

A. Which apparatus do you mean, the first or the second one?

Q. 26. The first and the second, each successively.

A. The first apparatus was the ordinary apparatus which was used at Procter & Gamble's works, which commenced to leak about ten hours after the operation had commenced; a small amount of steam escaped aside of the rod which guided the pump. The escape, which was not very large at first, became gradually inconvenient and scattered the fat over the whole place, and for that reason the experiment was discontinued. The stuffing-box inclosing
1207 the rod which guided the pump gave way. The other apparatus, when broken, filled the working-room where samples were taken with heavy fumes of acroleine. The pipe which carried the fatty mixture from the coil into the cooler was broken, and dense fumes of acroleine and fatty vapors filled the room to such an extent that we discontinued the operation. This had taken place

just previous to the taking of the eleventh sample. Considerable lowering of the temperature at the outlet is thereby easily understood, because not so much fluid passed out through the water from the coil, and the cooling, therefore, was more complete.

Q. 27. State just when these experiments on a working scale in the defendant's factory were conducted, and, if you can, who attended to the mechanical working of the apparatus.

A. In the first experiments which were made in the ordinary tanks which are daily in use at the defendants' factory, the regular employees of the place attended to them and gave us an opportunity to see what pressure the tanks carried by attaching to them their pressure gauges. The experiment which was made in the Tilghman coil was altogether under the supervision of a gentleman who was introduced to me as Mr. Hill, the engineer. The first experiment which was made in the ordinary apparatus of Procter & Gamble was commenced on the 10th of May and carried out through the night and the next morning, and the other experiment was commenced on May 11th. I was not all the time with the apparatus on the first experiment, but I took turns with Professor Morton, I being there part of the time and Professor Morton being there the rest of the time. It was constantly under the supervision of Professor Morton or myself.

Q. 28. You have spoken of the pressure-gauge varying somewhat from 2,000 pounds during the experiments with the coil ap-
1208 paratus; state whether or not you endeavored to keep the pressure at any particular point, and, if so, what?

A. I believe I did not do anything else than to merely go and call the attention of the engineer to remedy it. I had nothing to do with the apparatus; I merely made my observations.

Q. 29. For what purpose did you call his attention to the variation when it occurred?

A. So as to regulate it, if it was in his power to do so.

Q. 30. Had you any other means of determining the temperature to which the material was heated in passing through the coil than by the melting of the different substance to which you have referred?

A. No, sir.

Q. 31. When you speak of the time occupied in passing the material through the coil as being in excess of ten minutes, do you refer to the time occupied in passing through that coil in which the heating takes place, or did you include, when you say it was in excess of 10 minutes, the time occupied in passing through the coil and the cooler as well?

A. If I spoke of excess of ten minutes, the cooler is included in the time.

Q. 32. State whether or [not], in the experiments made with the Tilghman coil apparatus, any acroleine resulted or was given off.

A. The acroleine was observable atmost from the commencement of the operation, but very faint at the first. The quantity of acroleine increased with the increase of the temperature, and was quite

noticeable from the time that the lead commenced to melt, and increased from there on until the end of the operation.

Q. 33. What does the giving off of acroleine indicate?

A. Decomposition of glycerine.

1209 Q. 34. What means have you of knowing what processes of separating fatty acids and glycerine having been carried on both in this country and abroad?

A. My knowledge is partly derived from practical experience by having been in various factories where such decompositions are carried out, but more yet from the literature upon the subject, and also partly from the experiments I have made myself in comparing various methods of saponification.

Q. 35. Where have you been in factories where this work was carried on?

A. In Germany, in Jersey City, and in Cincinnati.

Q. 36. In what places in Germany?

A. A factory at Heilbronn, which I have repeatedly visited with my students in the years from 1864 to 1867. In Jersey City I have visited the factory of Gross & Co., and in Cincinnati the factory of Messrs. Procter & Gamble; I have also made soap myself at one time.

Q. 37. Are you familiar with the literature relating to the process of decomposing fat into fatty acids and glycerine?

A. Yes, sir. I do not say that I have read everything, but I have read a good deal about it.

Q. 38. Do you know, either from your practical observations or from any information obtained by your reading and studies, of the separation of fat into fatty acids and glycerine being carried on, on a manufacturing scale for practical purposes, either now or in the past, by the use of water, heat, and pressure, without other agents; if so, how extensively?

A. My knowledge of the literature or printed publications is that various attempts have been made in Europe and elsewhere to introduce saponification of fat by water, heat, and pressure; but they all, as far as my knowledge goes, have been abandoned on account of the fact that a complete saponification of fat by water alone is impracticable. In Dingler's Technological
1210 Journal, vol. 214, pp. 56, 57, and 58, published October, 1874, is an article of Birnbaum of an investigation which he has made with regard to the saponification process, which was employed in a factory in southern Germany; this particular factory was situated in Mannheim; it is not stated in this article, but I know it from other sources. I will furnish a translation and attach it to my testimony, having the same marked "Defendant's Exhibit Birnbaum, Dingler's Polytechnic."

A French chemist, Berthelot, states that fats can be produced by heating glycerine and the fatty acid together, and it is therefore absolutely necessary that a certain temperature is kept, in order to effect complete saponification, and if that certain temperature is not kept then the unification of the particles which had been split in two may take place again. This is stated in Wagner's Jahresbericht

for the year 1863, page 665. I will furnish a translation of the passage and attach it to my deposition, having it marked "Defendant's Exhibit Berthelot, Wagner's Jahresbericht."

In the report of Wagner for the year 1864 I find, on page 630, a report of Melsen's apparatus in a factory at Antwerp, as worked with the use of water and a pressure of 10 to 12 atmospheres, and that they have been compelled, in order to obtain satisfactory results, to add to that water from one to two per cent. of sulphuric acid, as otherwise only a portion of the fat will be saponified. I will furnish a translation of the article and attach it to my deposition, having it marked "Defendant's Exhibit Melsen's Apparatus."

Similar statements with regard to the insufficiency of water—that is, water under pressure and corresponding heat—are found throughout the literature.

Q. 39. What is meant by saponification?

A. All processes which tend to disrupt the union between the fatty acid and glycerine radical are classed under the name of saponification.

1211 Q. 40. Please enumerate briefly some of the processes that are classed as saponification processes?

A. The oldest saponification process is the one in which ordinary soap is prepared by means of alkali and fat. The second oldest process for the disruption of the union of these two constituent substances, which make up fat, is the treatment with sulphuric acid; by this method, as it was carried out originally, only fatty acids were made, without regard to the manufacture of glycerine; later, however, this method was modified to such an extent that the saving of the glycerine became possible. Then, the next in order, is the old lime-saponification process, by which, for the decomposition of fat, a large excess of lime was used, in order to produce the decomposition of the fat, and which was carried out at a temperature not above the boiling point of water under the ordinary atmospheric pressure. Gradually this amount of lime has been reduced to such an extent that only small quantities of lime are employed, while the temperature of the liquid was increased by the application of steam-tight apparatus. About the same time that these experiments were going on a number of methods were in use by which fat was decomposed by the use of steam and water, in the way of steam affecting the decomposition; later on, Berthelot, of France, Mr. Tilghman, of England, and the Melsens, proposed a modification of this method, which does not differ from the method of using steam, as far as the chemical reaction is concerned. I believe those are all the methods.

Q. 41. Can you refer to standard authorities supporting the definition of the term saponification which you have given above? If so, please do so.

A. I have never used the word in any other sense. I will give, as reference, "Fowne's Manual of Chemistry," London edition,

1212 1868, page 663; "Allen, Commercial Organic Analyses," vol. 2, page 120; "Muspratt's Chemistry," German edition of 1877, vol. 4, page 458. In "Erdmann's Journal fuer Practische Chemie," vol. 12, page 385, published in 1837, there is an article,

translated from an article of Edmond Fremy, which appeared in June, 1837, which states that sulphuric acid acts upon oils, and produces a kind of saponification, and that the product of the action has been called sulphate of soap. Mackeye, in his "Dictionary of Chemistry," speaks of it as a sulphate of soap. I will prepare extracts and translations, from the works quoted, of those particular parts which bear upon the question asked, as a part of my deposition.

Q. 42. Suppose you took the neutral fats actually used in a saponification process, selecting a high grade of material, what would be the highest theoretical percentage of fat acid which could be obtained?

A. If the fat should entirely consist of tri-stearine, the highest percentage would be 95.7–10ths per cent.; if it was of tri-oleine, 95.7–10ths per cent.; the difference in the second decimal is not worth mentioning. If the fat consists completely of tri-palmitine, the theoretical quantity which we may obtain from it is 95.2–10ths per cent. The neutral fats in tallow are mixtures of tri-stearine, oleine, and palmitine in various proportions; and the consequence is, that the amount of fatty acids which can be obtained from one hundred parts of fat cannot be higher than from 95 and 2–10ths to 95 and 7-10ths per cent., provided the fat is all decomposed.

Q. 43. If, in working any process of such saponification, a larger percentage than that you have named appeared to be produced, how would you account for it?

A. That the fat had not been completely decomposed; that some neutral fat had remained in the acid.

1213 Q. 44. Would the product, as a whole, be more or less valuable by reason of the increase of the quantity thus obtained; in other words, would the entire product, including the additional percentage made up of other ingredients, be more or less valuable than the percentage of pure fat acid which would result from perfect saponification?

A. An increase in the quantity of fat acid obtained always must indicate an incomplete saponification; and there would be, therefore, a certain amount of neutral fat, which would depreciate it considerably in value.

Q. 45. Why would it depreciate it?

A. The presence of a neutral fat in the stearic acid would prevent the ready crystallization of the acid, especially the formation of larger crystals of the acid, and in this way prevent the obtaining of the finer quality, or a high grade of fatty acid. If all the neutral fats are pressed out the yield of free stearic acid would be extremely small, as the fat has the property of dissolving the stearic acid—carrying it away into the waste oleic acid.

Q. 46. You have spoken from time to time of the "Tilghman process;" what have you included in that process; have you used the term as limited to the particular apparatus or degree of temperature mentioned in the patent, or have you used it with a broader signification?

A. I have used it in a broader signification, for the reason that I understand that the Supreme Court has adjudicated that all tem-

peratures above the boiling point, where pressure is used; would be included in the patent. Otherwise, from my own reasoning, I have considered the limit to have existed in nothing but the use of the apparatus which is specially described.

1214 Q. 47. How do you account for the fact that, in the various tests and experiments you have made with this Tilghman process, you get so small a per cent. of fatty acid?

A. I account for that on theoretical reasons, because the real fats may be produced, as I have mentioned already before, by the action of glycerine upon the fatty acids so that, under certain circumstances, reunison of the separated substances takes place. It is also a well-recognized fact that if we take, for instance, ethers and treat them with water, there will be a certain degree of decomposition; also, if we take, for instance, the acid and alcohol and desire to reunite them, we can never do that without other means completely. In other words reaction will only reach a certain point; after that certain point has been reached the acid and alchol will lie side by side without acting upon each other. As far as decomposition is concerned the same facts will hold good in an opposite sense.

Q. 48. Are fats, chemically speaking, ethers?

A. Yes; they are.

Q. 49. When was the artificial production of fats from glycerine and fatty acids acids first accomplished, so far as you know?

A. In the 1853.

Q. 50. By whom?

A. By Berthelot.

Q. 51. Can you refer to any authority upon that and quote it?

A. Berthelot's Synthesis of Fats, Liebig & Kopp Year-Book, 1853, page 451.

Q. 52. Will you produce, to be made an exhibit in the case, the extract referred to?

A. Yes, sir; I will do so and will have it marked "Defendant's Exhibit, Berthelot's Synthesis of Fats."

1215 Q. 53. Would there, in your opinion, be such a reunion of the constituents uniting neutral fats take place to the same extent where the process of saponification was carried on by the use of heat, water, and pressure without other agents, and what is your reason for your opinion?

A. I am not prepared to answer that question directly. I am only acquainted with certain facts; I have repeatedly heated fat, under varying circumstances, with water alone, and always have come to the conclusion, as others have done before me, that water cannot completely decompose the fat; that there will, and must, be a certain residue of unsaponified fat, which is larger for lower temperatures and smaller for higher temperatures; whether, now, this is brought about that, at certain times, the liberated acid and liberated glycerine unite again, or whether decomposition goes on to a certain point where equilibrium is established in the mass, I do not know.

Q. 54. Have you read the exhibit extract from Roret's Encyclo-

pedia, page 474 of the Supreme Court transcript, and the patent of DeMilly and Motard, therein referred to, and do you understand it?

A. I have read this extract and believe I understand the same.

Q. 55. Referring again to Exhibits No. 4, page 247 of this transcript, and Exhibit No. 10, page 251, please state whether or not you have made any experiments determining the effect of the process therein referred to; and, if so, what?

A. I have made such distillation as has been described by Debrufraut.

Q. 56. Describe the experiment which you made and state what kind of a product you obtained.

A. The apparatus in which the decomposition of fat took place was a copper cylinder, into which a pipe was carried from above, which carried into the retort or cylinder the divided vapors of water; the copper vessel and contents were heated from the outside
1216 by a gas-lamp, and on the inside by the application of superheated steam carried through the retort, and, consequently, through the mass contained in it. The water as soon as it came in contact with the fat decomposed the fat into glycerine and free fat acids, and both the glycerine and the free fat acids distilled over. The sample of the fat acids which were obtained at the first distillation, which, owing to some slight difficulty with the apparatus, was not what it ought to have been, was about 99 per cent. The second experiment was pure acid. The first sample in the first experiment was impure because of a certain bumping going on carrying over a certain amount of fat. The second was pure. The residue, which was left in the retort, contained 3.7–10ths per cent. of free acid, while the fat which I used for this first experiment contained less than one per cent. of free acid before the operation was commenced.

Q. 57. Where did the fatty acid and glycerine distill to?

A. Into a cooling apparatus in which they were condensed.

Q. 58. What was the character of the glycerine obtained in this process?

A. It was pure good glycerine.

Q. 59. Was there any acroleine?

A. In the first experiment there was to a certain extent; the apparatus was out of order; occasional jerks caused the production of a certain amount of acroleine. In the second experiment there was not a trace of acroleine.

Q. 60. Who was present when those experiments were made?

A. Professor Morton and his assistant, Dr. Geyer; they participated in making the experiments.

Q. 61. State whether or not the instructions contained in these Exhibits, Nos. 4 and 10, and with the ordinary chemical
1217 knowledge as it existed at that date there would be any difficulty in obtaining these products by following the directions there given?

A. Not the slightest.

Q. 62. What do you understand to be the reaction that took place

in the process described in those Exhibits No. 4 and No. 10? Was the fat distilled as stated?

A. The fat was at first decomposed by the water by uniting with the water, and thereby free fat acid and glycerine were formed, and, both being volatile in steam, were carried over into the cooler.

Q. 63. Then what was the agent that effected the decomposition of the fat?

A. The water.

Q. 64. What was the temperature?

A. The temperature was in the neighborhood of 300 degrees centigrade, which is a little below the melting point of lead.

Q. 65. Can you state exactly what the temperature centigrade was?

A. It was about 280 degrees, but the temperature would vary from time to time, going a little higher sometimes and a little lower, but the average temperature was about 280. The patent says that decomposition should be effected at between 200 and 330 degrees centigrade (or 536 degrees Fahrenheit).

Q. 66. Please state whether or not the chemical reaction which takes place upon fats with steam at any different temperature is different in kind from the reaction taking place with water at the same temperature.

A. The action is exactly the same, only that in this case the products of decomposition, or fatty acids and glycerine, carried away by the vapor are such as will complete the decomposition of the fat, while in the other case, where the glycerine and water remained in contact with the fat, decomposition seems not to be obtainable.

1218 Q. 67. Referring, now, to exhibit from Roret's Encyclopedia, page 474, and the DeMilly and Motard patent therein referred to, have you made any experiment which would determine the practical effect of the process therein referred to?

A. I have.

Q. 68. Please describe those experiments, and state the results.

A. The article in Roret mentions that it has been frequently suggested that the lime in the process of saponification may be considerably reduced if pressure is used. The pressure which was found, probably owing to the more incomplete facilities which boiler makers at that time could offer, was not much above that which would correspond to the temperature of 277 degrees Fahrenheit, which is a little over thirty pounds pressure. The modern industry gives facilities in furnishing us steam-tight apparatus of far greater strengths than were used in former years, and, therefore, it was possible to reduce the lime to a very small quantity; consequently I made a series of experiments in the presence of Professor Morton and his assistant, who was present in all cases but one, to determine the action of lime in the presence of water under greater pressures. I used in these experiments one per cent. of lime. I mean, by one per cent. of lime, one per cent. of the weight of fat. Two experiments were made—one with ninety pounds and the other with one hundred and fifty pounds pressure. As a result of these experiments I found in one

experiment 84.18-100ths per cent. of free acid had been produced, and this in the case of a fat which had less than one per cent. of free acid, while in the other, where a higher pressure was used, 88.7-100ths per cent. of free acid was produced. I should mention here that the fat was tested only after the lime had been removed by the aid of sulphuric acid.

1219 Q. 69. State whether or not, in your opinion, the description contained in these exhibits is sufficient to enable a chemist, with a knowledge of the art that existed at the time, to practically work out the process and obtain the results you obtained.

(Mr. Chambers, counsel for complainant, objects to the question.)

The MASTER: The objection is overruled.

Mr. CHAMBERS: I will take an exception.

A. I am confident that it would have been possible with the knowledge that existed at that time with regard to saponification processes.

Q. 70. What is the difference between the defendants' process as described in the record and the process set forth in the extract from Roret, as you have observed; are you familiar with it as described?

A. The main difference between those two processes is that the defendants' process is carried out at a pressure of from 200 to 250 pounds, and that after the operation has been continued for, say, nine or ten hours a change of water takes place, and thereby the product is finished, while in the experiment I have made, together with Professor Morton, only one water was used and less pressure.

Adjourned until to-morrow.

TUESDAY MORNING, *May 15th*, 1883.

Q. 71. In what respect is the process worked in the defendant's factory distinguished from what we have spoken of as the Tilghman process? I mean to include in the term "Tilghman process," as here used, any saponification by means of heat, water, and pressure without other agents.

1220 A. The defendants use heat, water, pressure, and lime, and Tilghman uses merely water, pressure, and heat.

Q. 72. Is there any other distinction?

A. There is; the defendants change their water after the process has gone to a certain extent; they draw off the first water and work the same fat with fresh water.

Q. 73. Has this change of water any agency in affecting the result?

A. From the examinations which I have made I am confident that it has.

Q. 74. What reasons can you give for this opinion; what examinations is it based upon?

A. In various samples which were obtained with the aid of pressure, heat, and water, in the presence of one per cent. of lime, the highest results, as far as the production of free fatty acids in the acid

mixture was concerned, was eighty-eight and six-tenths per cent. I received some time in the month of April from Professor Morton a sample of fatty acid which had been treated in the same manner at the works of Messrs. Procter & Gamble, with the exception that the water had been renewed. The amount of fatty acids which was found in this mixture was ninety-seven and a half per cent. of free fatty acids in the whole fatty mixture which was sent for examination. The same comparison has been made with the products obtained by the Tilghman process, under the conditions of work at defendants' factory, omitting the lime, but the amount of free fatty acids obtained under those circumstances, or the increase of fatty acids by the change of water, was far less than in the case where the lime was present.

Q. 75. When you speak in your last answer of ninety-seven and a half per cent. of free fatty acids as obtained, do you mean that that per cent. of the product obtained was free fatty acid, or
1221 do you mean that that per cent. of the fat was obtained as free fatty acid?

A. I mean thereby that the fat mixture obtained from the fat contained ninety-seven and a half of free fatty acids and two and a half per cent. of undecomposed fat.

Q. 76. Can you now refer to any authority confirming the statement you have hitherto made as to the maximum amount of fatty acids from neutral?

A. In Muspratt's Hand Book of Technology, latest German edition, vol. 4, p. 455, the statement is made by Stass that purified tallow produces ninety-five and five-tenths to ninety-six per cent of free fat acids, and that fresh palm oil produces ninety-three and five-tenths to ninety-four per cent.

Q. 77. In the treatment of fats with heat and water how do you explain the difference of yield of fatty acid when the one per cent. of lime is used as compared with the use of these agents without any lime?

A. The lime will convert some of the fat into lime soap. If water carries the decomposition to a certain extent lime will finish the operation and make a merchantable product. If, for instance, water would cause a decomposition producing a product containing eighty-four per cent. of free fatty acids lime will go beyond that and produce a product, in accordance with the fact that lime will decompose a certain portion of the fat, forming lime soap. Whether this lime soap which is produced is only neutral lime soap, or whether the lime may act in such a way that an acid lime soap is produced, is a question which is somewhat doubtful. Though it has been stated in the records over and over again by the experts on the Tilghman side that no acid salts of the fatty acids exist, we know that a great many are in existence. There is only one link wanting in this; that is the actual production of the acid lime salts. Acid salts of lime with fatty acids of less complicated composition than the non-vola-
1222 tile fat acids are known. On account of their insolubility salts of the higher fatty acids may have been overlooked, though they may exist. In that case, of course, the lime might be

able to carry the saponification much further than if only neutral lime salts were obtained. At any rate one per cent. of lime will cause the saponification of eleven per cent. of fat. But if an acid salt should exist the decomposition might be carried further to the extent of twenty-two per cent.

Q. 78. What is the equivalent in lime for a hundred pounds of neutral fat?

A. About nine and a half pounds.

Q. 79. What is the difference between glycerine obtained under the Tilghman process, where heat, water, and pressure only are used, and the glycerine obtained where one or more per cent. of lime is used for the saponification?

A. The glycerine obtained in the Tilghman process is free from any lime, while the glycerine obtained in a saponification process where lime is used will always contain lime.

Q 80. Where lime is used, either in the quantity used in the defendants' process, or in larger quantity, what treatment is necessary before the glycerine goes to its accustomed uses or is fit for such uses?

A. It has to be freed from lime.

Q. 81. Is this equally true whether one per cent. or a larger amount is used?

A. I should think so; yes, sir.

Q. 82. What is the process by which the lime is removed?

A. By sulphuric acid in the first place, and by the application of bone-black as the second step in the refining of glycerine.

Q. 83. Is there any other step?

A. If merely glycerine for mere ordinary uses is to be made there is no further step. If the finest qualities of glycerine are to be manufactured, distillation will come in and remove the lime salts completely. 1223

Q. 84. Is not this distillation necessary to qualify the glycerine for most uses to which it goes?

A. It is.

Q. 85. When was this process of distilling glycerine first invented?

A. In the year 1855.

Q. 86. Can you refer to authority upon that?

A. The distillation of glycerine was first carried out according to a patent by G. F. Wilson and G. Payne in 1855. This statement is contained in the authorized reprint of the official report on the Vienna exhibition for the year 1873, in an article by K. Kraut, professor of chemistry at the Polytechnic Institute at Hanover, in Prussia, in the third volume, page 506.

Q. 87. Please make a translation of the paragraph referred to as an exhibit, to be marked "Exhibit Kraut Fat Industry and Glycerine."

A. I will do so.

Q. 88. Name some of the principal uses to which glycerine is now put, stating, as nearly as you can, when the several uses originated, and, in connection with your answer, state your sources of knowledge.

A. Very large quantities of glycerine are used in the manufacture of nitro-glycerine, which enters into the composition of a great many substances which may be classed under the general name of dynamite. Nitro-glycerine was discovered in the year 1847 by Sobrero, but it was for many years not in use until Noble, in the year 1863, discovered an easy method of preparing it which was entirely without danger. I refer to the history in general in Musprat's Chemistry, German edition, vol. III, page 412, and so on. Very large quantities of glycerine are used on account of its chemical properties, but chiefly because it is recognized as a food substance,
1224 for the reason that Pasteur discovered that it is a regular product of fermentation, and is contained in all fermented liquors. (Compt. Rend., vol. XLVI, page 357.)

On account of its physical properties it is used for the purpose of preventing substances from becoming dry, as for instance, ink, especially copying ink, tobacco, and it is also used as a cosmetic. It is used for filling gas meters, so they will not freeze, and is used to a certain extent in dyeing. It is used as a preservative. It is used to keep leather belts from cracking. It has been proposed for the prevention of boiler incrustations. It is used in combination with other substances for the production of cements; used in whisky, beer, and wine. All these applications have been found for glycerine since it has been possible to obtain the glycerine sufficiently pure. The statements I have given can be found by reference to Wagner's Index.

Q. 89. Please refer to such articles relating to this subject as are readily accessible in the volumes you have cited; state specifically to what branch of the subject they refer and the volume and page where they are to be found.

A. Can I use this index to Wagner's Year Book, prepared by Dr. F. Guttschalk, for the volumes I to X and XI to XX?

(Master ruled that the witness might use said index for the purpose of refreshing his recollection, but that he could not be allowed to quote from it; to which ruling counsel for defendant excepted.)

Q. 90. State whether or not you are familiar with and have been in the habit of using this Wagner's Index as a means of referring to the articles purported to be cited therein, and whether or not it is a recognized standard in your profession as a guide to such
1225 articles, and whether or not, in your use of it, you have found the citations to be correctly made.

A. I am very frequently in the habit of using this book. It is considered an authority with regard to the books of which it purports to be an index, and I find that the references made therein are reliable.

Q. 91. Please make from it a translation of the references on the subject of glycerine therein contained, or those you deem most important in this connection.

(Objected to by counsel for plaintiff. Objection sustained, to which exception was taken.)

Q. 92. Please refer to the more import articles upon the subject of glycerine to which reference purports to be made in the index above referred to, verifying your references by the volumes themselves, and giving the particular branch of the subject to which the articles severally purport to relate, and the page and volume in which they are found, translating the titles to such articles.

A. I will prepare the list called for.

Q. 93. Please state how, in your opinion, based upon your own experiments and your chemical knowledge, the process of saponification, by means of heat, pressure, and water, without the use of other agents, would compare in utility for manufacturing purposes with what is known in this record as the old lime-saponification process, giving your reasons for any opinions you may express.

A. The distillation process and the old lime-saponification process yielded, practically, pure fatty acids without any undecomposed fat. The yield of fatty acids after pressing is, under such circumstances, always the highest possible to be obtained. The product which comes from the presses shows always a higher melting point than can be obtained by any process which does not produce a
1226 complete saponification. The process by water compared with those processes which I have just mentioned will never produce a pure acid mixture, by which I understand the fatty mixture containing only the fatty acids and no undecomposed fat. For this reason there will be, on submitting the fat to the further processes which precede the making of candles proper, and which consists in cold and hot pressing of those fatty cakes, either a smaller yield, or, if a larger yield is actually obtained, the melting point of the ready material will be found considerably lower. The process carried out by water will, therefore, give entirely different results if the same raw material is submitted to it and to any of the other processes.

Q. 94. When you speak in your last answer of obtaining a larger yield from the process where water, heat, and pressure only are used, do you mean a larger yield than is obtained by other processes, or what do you mean?

A. I merely mean in comparison with the yield which may be obtained from the same fatty acid mixture and without any reference to the yield which may be obtained by other processes of saponification.

Q. 95. As a means of separating fat acids and glycerine on a manufacturing scale, what, if any, would be the practical economy and advantage of any process which used heat, pressure, and water as the sole agents of decomposition as compared with either the old lime-saponification process or the distilling process?

A. A process using simply water and heat and pressure would, if it were possible to carry it to a successful end—by which I mean that the neutral fats are completely decomposed—have advantages on account of the fact that no chemicals are used, and that the glycerine would be perfectly free from any foreign substances, especially of an inorganic character.

1227 Q. 96. Would or would not this advantage exist where one per cent. of lime was present?

A. The advantage in the process, as far as glycerine is concerned, would certainly not exist.

Q. 97. Is or is it not practicable to carry the process where heat, water, and pressure alone are used to what you refer to as a complete separation?

A. It is, according to the literature I have quoted, and according to my own experience, impossible to carry the water process to a successful end in the manner in which it has been described in the Tilghman patent.

Q. 98. Is it practicable in any other manner that you know of?

A. In no manner that I know of.

Q. 99. Now, having reference to results actually obtained in the saponification process carried on by water, heat, and pressure, without other agents, what would be the per cent. in utility, as a means of working upon a manufacturing scale, between this process and either the old lime-saponification process or the distillation process?

A. This would entirely depend upon the result which is desired to be obtained. If it is desired to make pure stearic acid, and get the highest yield and an excellent product, the process by water, heat, and pressure alone would never be used.

Q. 100. For what practical purpose, if any, could it be used to advantage as compared with either of the other processes above referred to?

A. It could be used for the manufacture of very low grade products. It would also produce, as far as the fat acids are concerned, glycerine free from the inorganic substances directly. If it be used for manufacturing glycerine, which does not need any distillation, the fatty acids would be without much value, as the process is an incomplete one. Candles made therefrom would be either costly,

1228 on account of the small quantity of the yield, or they would be of a low grade, being partly tallow. The advantage may come in when one of the products would bring such a high price that the other might be neglected. If, for instance, the manufacture of glycerine, independent of the production of the fatty acids, would make the process pay, the process could certainly be applied to advantage. This question, however, is a purely hypothetical one, and, in the ordinary manufacture, as it is carried on at the present time, the two products must help to pay for the process.

Q. 101. Am I to understand by your last answer that, for the purpose of obtaining the glycerine, where the fat acid was to be rejected, this process with heat, water, and pressure alone would be advantageous as compared with the lime-saponification process and the distillation process?

A. It would not be advantageous under the present circumstance and the prices, considering the price which glycerine brings.

Q. 102. How much more advantageous, if at all, than either the old lime-saponification process or the distilling process would this process be where the object was to obtain glycerine only, supposing

the price of glycerine to be sufficient to warrant the carrying on of the business for that purpose solely?

A. It would be not advantageous as the case stands on account of the yield of the glycerine being greater in the use of the lime process. The difference would be only—may be—in the price that the glycerine might bring on account of the one containing lime and the other being free from lime.

Q. 103. How much more advantageous, if at all, would it be, supposing the glycerine was the only object, to obtain the pure glycerine by the process using heat, water, and pressure only than it would by the old lime-saponification proces and subsequent refinement and purification of the glycerine?

1229 A. Well, it would depend entirely upon the cost of the various methods.

Q. 104. I understood you to say in a former answer that for the purpose of obtaining glycerine, where that was the only product desired, the process of saponification by heat, water, and pressure would have an advantage for manufacturing purposes over either the process by distillation or the old lime-saponification process. If the water process has a practical advantage for this purpose, what is the extent of that advantage?

A. Distillation is made superfluous.

Q. 105. Distillation of what?

A. Of the concentrated glycerine.

Q. 106. Is the cost of distillation of glycerine a large item as compared with the other costs of producing glycerine?

A. It is a considerable item.

Q. 107. Can you state about what proportion it bears to the cost of saponification and of the materials?

A. I cannot.

Q. 108. What reason have you for the opinion that it would be any cheaper or more advantageous to obtain pure glycerine by the saponification process, using only heat, water, and pressure, than it would by either of the other processes and subsequent refining or purification of the glycerine?

A. Glycerine has to be treated with chemicals in order to remove the lime, while the same treatment is not required in the case where no lime is used.

Q. 109. Would or would not the cost of obtaining the same amount of glycerine by the heat and pressure process be equal to or greater than the cost of obtaining it by the lime-saponification process, including also the cost of refining it with the latter?

A. I cannot tell.

Adjourned till 3 o'clock p. m.

1230 TUESDAY AFTERNOON, *May 15th*, 1883.

Examination of H. ENDEMANN resumed by R. H. PARKINSON, Esq., solicitor for respondents.

Q. 110. Assuming that the saponification process is carried on for the purpose of utilizing the fat acids, as well as the glycerine, state

what, in your opinion, would be the comparative utility of the process, using heat, water, and pressure without lime and the old lime-saponification process?

A. The old lime-saponification process would be, as far as utility is concerned, far superior to that using heat, water, and pressure.

Q. 111. Make the same comparison between the process using heat, water, and pressure without lime and the old distillation process.

A. The value of the products obtained by the old distillation process would be greater than the value of the products obtained by the process using water, heat, and pressure.

Q. 112. By which of the two processes mentioned in the last question would the same amount and value of product be cheapest obtained?

A. By the distillation process.

Q. 113. Can you cite and translate any authority tending to show what was done with glycerine prior to 1853?

A. I have a statement here, printed in the official report of the Vienna Exposition in 1873, made by K. Kraut, which I will translate and file herewith as "Kraut 504."

Q. 114. Please state whether or not the various works which you have cited in your deposition, and from which you have made quotations, are recognized as standard authorities in the science to which they relate and upon the point to which they are cited.

1231 A. The books from which I have frequently quoted are recognized among chemists as standard authorities.

Q. 115. Please make and offer as an exhibit herein a translation of an extract from Kraut's report upon the Vienna Exposition, 1873, vol. 3, part 1, page 494, of authorized reprint.

A. I will do so.

The solicitor for respondents offers in evidence the following exhibits, being translations and extracts made by witness in accordance with answers above given, to wit:

No. 1. Birnbaum, Dingler's Polytechnic, vol. 214, page 56, and Musprat, 1877, vol. 4, page 479.

No. 2. Berthelot, Wagner's Year Book, 1863, page 665.

No. 3. Wagner's Year Book, 1864, page 630.

No. 4. Fownes, 1868, page 663.

No. 5. Allen, vol. 2, page 120.

No. 6. Musprat, 1877, vol. 4, page 458.

No. 7. Erdman's Journal (Fremy), 1837, vol. 12, page 385.

No. 8. Berthelot, Liebig and Kopp, Year Book, 1853, page 452.

No. 9. Kraut, Fat Industry and Glycerine, Vienna Exposition Report (reprint of 1877), vol. 3, page 506.

No. 10. Kraut, Fat Industry and Glycerine, Vienna Exposition Report (reprint of 1877), vol. 3, page 506.

No. 11. Musprat's Hand Book of Technology (German edition, 1877), vol. 4, page 455.

Cross-examination by F. T. CHAMBERS, Esq., solicitor for complainants:

X Q. 1. You have stated that you have read what you consider the most important parts of the transcript of record in this case; how did you distinguish the important from the less important parts?

1232 A. By partly reading the testimony therein given; if it bore upon chemical questions, I continued it. If it bore upon other questions, I discontinued it. I read the exhibits, except a few which contained correspondence between interested parties.

X Q. 2. Can you state what depositions you read?

A. I read the patent granted to Mr. Tilghman. I did not read the correspondence between Mr. Proctor and Mr. Tilghman. I read the defendant's answer with the exhibits mentioned in it; and also read some of the exhibits in the original—for instance, Roret's. I read the deposition of Wolcot Gibbs, James C. Booth (I do not know whether I read both of his), R. E. Rogers, page 75 to 81, Frederick A. Ghent (both depositions), Florence Verdin, page 156, Peter H. Venderweide, page 163, R. Ogden Doremus. I read the report of the commission to John Baptiste Moucir. I read the deposition of John Lawrence Smith, page 791; Edward S. Remvig, 945; Charles F. Chandler, 956, and a number of others which I can not identify by name, and I cannot tell how much I read from the others.

X Q. 3. When was this case first brought to your attention?

A. In January of this year.

X Q. 4. Prior to that time what experience had you in the manufacture of fatty acids and glycerine.

A. I had taken my students twice to a factory in Heilbroun to witness the decomposition of fat by lime in the manufacture of candles. I also, when a student, had been to a factory in Hesse-Cassel. In both cases the old lime-saponification process was in use, and the glycerine was allowed to run to waste, excepting that, at the Heilbroun factory, they admitted that they had made small quantities of glycerine on several occasions. Besides that, I had derived most of my knowledge of the fat industry from literature up to the time

1233 I was called upon in this case. On one occasion, in 1868, I think, I made some soap from neutral fats. I have also carried out some experiments in the laboratory when I was assistant professor at the Polytechnic, in Stuttgart, as, for instance, the Miges Mourries emulsion saponification process.

X Q. 5. What percentage of lime was used in the two factories you visited?

A. About fourteen per cent. in the Heilbroun factory. I could not state what it was in the other.

X Q. 6. State what the process was as used in these two factories.

A. Water, fat, and lime, previously slacked to milk of lime, were brought together, and the whole heated while the mass was stirred. The mass increased in consistency, and the heating was continued for a certain number of hours. The mass was then transferred to

lead-lined boxes, where it was decomposed by sulphuric acid with the application of some heat. The fatty acids would collect at the top of the boxes and would be drawn off, allowed to cool, and pressed ready for the manufacture of candles. That was the whole process of obtaining the fatty acids, so far as I saw it.

X Q. 7. How long did you remain at the factory on each of your visits?

A. A couple of hours. I took the students around and explained to them the uses to which the apparatus was put and the process generally.

X Q. 8. What percentage of sulphuric acid was used in these works?

A. I understand that the quantity of sulphuric acid used was about double the quantity of the lime, but I do not know that I made any special inquiry.

X Q. 9. What was the density of the glycerine water resulting from the saponification of the fat, and was it acid or alkaline as it was run off.

A. I suppose it must have been alkaline, on account of the large quantity of lime used. As for the specific gravity of the water, I could not make any examination under the circumstances.

1234 X Q. 10. How much water was put into the saponifying tub in proportion to the fat?

A. I could not tell; it was about eighteen years ago.

X Q. 11. Besides the experiments of which you have spoken have you made any other experiments since you were employed by the defendants?

A. We commenced a number of experiments, but did not carry them through on account of the mechanical apparatus being imperfect. A number of experiments were started which were not completed.

X Q. 12. What were the uncompleted experiments?

A. They belonged to the series of Roret's experiments and the Tilghman experiments, both.

X Q. 13. What do you mean by the Roret experiments?

A. The experiments made with heat, pressure, lime, water, and fat.

X Q. 14. Did you complete none of these experiments?

A. I believe the first one was completed, but under some difficulties, so that the result could not be considered a fair one on account of some leakage through the stuffing box through which the stirring rod passed. Most of the water which had been added was lost by evaporation within the first three hours. The lost water, or perhaps more, was added again and the operation continued three hours more. At the end of that time the sample was taken out and examined.

X Q. 15. What was it like?

A. It was better than any of the samples afterward obtained; it contained about 88 per cent. of free fatty acids.

X Q. 16. What proportion of fat, lime, and water was used in this experiment, and what kind of fat?

1235 A. We used the same kind of fat in this experiment as in the others; it was carefully prepared in the laboratory from beef tallow obtained from the butchers and rendered by ourselves. The amounts of various materials used were fat, 1,000 grammes; lime, 10 grammes; water, 500 grammes.

X Q. 17. Did you use the same quantities and proportions in the other experiments?

A. In the others we used 500 grammes of fat, 1,000 grammes of water, and 5 grammes of quicklime.

X Q. 18. What was the heat in those experiments?

A. About 165° centigrade or 329° Fahrenheit.

X Q. 19. How was it stirred?

A. With a mechanical stirrer having a multiplying wheel inside—10 or 20 to 1. The crank outside was turned about 80 times per minute, making from 800 to 1,000 revolutions of the stirrer inside, which was made like an egg-beater, with several wire loops.

X Q. 20. Describe the vessel and how it was heated.

A. An iron vessel 15 inches in diameter and of the same height, lined with lead, heated by gas. It would hold about 3,000 grammes.

X Q. 21. Was the glycerine water obtained acid or alkaline, and of what density?

A. It was acid; did not measure the density.

X Q. 22 Were all your experiments, excepting the distillation experiments, conducted with this apparatus?

A. All them were made before we came to Cincinnati.

X Q. 23. How did you charge this apparatus and how get at its contents to take samples?

A. We unscrewed the cover to charge it, and did the same for the purpose of taking samples.

X Q. 24. What was the largest percentage of lime used in any of your experiments?

A. One per cent.

1236 X Q. 25. How many experiments in all did you make with this apparatus?

A. I could not tell. We commenced a good many, but on account of mechanical difficulties did not finish them all.

X Q. 26. How many complete experiments?

A. So that we felt perfectly safe with the results. Two.

X Q. 27. State the proportions of fat and water in those two experiments?

A. In one 500 grammes of fat and 1,000 grammes of water and 5 grammes of lime. In the other 500 grammes of fat and 1,000 grammes of water. No lime.

X Q. 28. How long did the treatment continue, and at what temperature?

A. It continued for six hours at a temperature of about 165° cent., measured by means of a thermometer inserted through a tube, which penetrated into the interior of the vessel, and which was partially filled with paraffine. The temparature was pretty near uniform.

X Q. 29. After reaching Cincinnati what further experiments did you try?

A. We made one experiment on a manufacturing scale, using with the fat water under heat and pressure only, and one experiment only using one per cent. of lime, in addition to the materials used in the other experiment. We also used the so-called Tilghman coil for the purpose of obtaining an insight into the working of this process.

X Q. 30. What did you do with the coil? How often did you use it?

A. I used it during a portion of one day. I was present when the fat and the water were weighed off, and timed the fluid in its passage through the coil, and also took samples from time to time, stating the hour and minute when taken, the pressure near the
1237 outlet, and the temperature of the fluid as it ran from the cooler. I also examined from time to time the wires which were inserted into the cavities of the apparatus in order to ascertain which of the metals were melted.

X Q. 31. These were all the experiments which you made, were they?

A. I have enumerated all, except the distillation experiments and those which were not completed, and of which I have no notes.

X Q. 32. How many distillation experiments did you make?

A. Two; the second one was complete; the first was in so far unsatisfactory, as by some minor fault of construction, for which the process cannot be blamed, the distillation was somewhat irregular.

FRIDAY MORNING, *May 18th*, 1883.

Cross-examination of H. ENDEMANN resumed by F. T. CHAMBERS, Esq.:

X Q. 33. What quantities of fat did you use in your two distillation experiments?

A. I think we used in each about the same quantity, 150 grammes.

X Q. 34. How long did you continue the first distillation?

A. For about one hour.

X Q. 35. At what temperature, so far as your apparatus showed it?

A. About 300° cent.

X Q. 36. And the temperature of the second experiment?
1238 A. About the same; perhaps a little lower. If I recollect aright, it was conducted at an average of about 280° cent.

X Q. 37. In the first experiment acroleine was produced, and you found neutral fats mixed with the distilled acids, did you not?

A. Yes, sir; I did find about one per cent. of unsaponified fat, and acroleine was formed at the end of the experiment; the temperature was lower than at the commencement, perhaps 250°, and acroleine continued to form at that temperature.

X Q. 38. What per cent. of the mass treated was distilled over in the first experiment?

A. About 20 per cent.

X Q. 39. And in the second?

A. I could not tell, but considerably more, perhaps 50 per cent. No account was taken of the amount distilled.

X Q. 40. How long did the second distillation continue?

A. About three hours, I think; I took no account of that either. The second experiment was continued for a considerably longer time than the first for the reason that we intended to ascertain whether the formation of acroleine was, in this case, a mere matter of time or whether its formation could be prevented by carrying on the distillation in a more steady manner than in the first one.

X Q. 41. Was Dr. Henry Morton present, and did he assist in these two experiments?

A. I could not exactly say in what manner he assisted in the experiments. I believe his assistance was mainly restricted to his presence. We were both in and out during both experiments; first one and then the other attended while they were going on. After the apparatus had been put together the whole work consisted in watching the apparatus, and while Professor Morton may not have
1239 weighed out the fat that was used in the operations, he certainly assisted in the subsequent observations.

X Q. 42. Why did you not continue either of these experiments until you had distilled the entire contents of your still, as must be the case in any practicable manufacturing operation?

A. The suggestion that the distillation must be continued to the end in any practicable operation is entirely unfounded, as fresh fat may be run into the still continually while the operation is going on. The object of the experiment was to ascertain whether the fats, previously to their distillation, would be converted into fatty acids and glycerine. It suggested itself to me, if such were the case, the fat remaining in the still, after it had passed through this operation, would contain more fatty acids than when put into the still. To make such an experiment it was necessary to discontinue the operation at some point before all the contents had been distilled.

X Q. 43. Did your experiments prove, in your estimation, that it was practicable to completely and economically distill neutral fats into fatty acids and glycerine on a manufacturing scale?

A. The experiments proved conclusively that it is possible to effect a complete decomposition of the fat into glycerine and fatty acids. The experiments were not made on a manufacturing scale, and, for that reason, deductions with regard to the economy of the method, could not be drawn.

X Q. 44. You swear then, as a matter of fact, that neutral fat can be entirely converted into fatty acids and glycerine by a steam distillation?

A. I do, as far as my experience goes, and I am not aware of any facts to the contrary, excepting a number of statements to the contrary in the Supreme Court record in this case, of which I remember several made by Prof. Booth. But the experiments of Prof. Booth are so entirely at variance with my own observations
1240 and well-recognized scientific facts, that I do not consider them worthy of credit. I believe rather that his experiments

have been made in the partial absence of the precautions that have been described.

X Q. 45. You feel quite safe, then, in asserting this as a matter of fact, and in severely criticising Prof. Booth for entertaining a contrary opinion, in spite of the fact that you don't know, from your own experiments, that any given quantity of neutral fat has been even half decomposed into fatty acids and glycerine by steam distillation?

A. If a given quantity of fat is decomposed by steam, free fatty acids and glycerine are formed, which distill, leaving the fat practically the same as it was before some of the fat had been decomposed. If I had continued, therefore, this process to a certain extent, I believe I am justified to conclude that the experiment might be continued to the end without any other results being obtained excepting that while the fat in the still diminishes in quantity the distillation may become irregular on account of the fact that some portions of the still are superheated while other portions are subjected to a lower temperature.

X Q. 46. How do you know that the residue left in the still was unaltered neutral fat, capable of a similar complete distillation?

A. The fat had the same appearance, almost, as the fat which had been put in. It was a little whiter and a little harder, and contained, according to my estimation, 3.7 per cent of free fat acid. I am not aware of the fact that the presence of free fat acid in the fat would prevent its applicability to the distillation process.

X Q. 47. Let me see if I understand your reasoning correctly. From your observation of this residue you found that it differed from the original charge of the still in being whiter, in being harder, and in containing more free fatty acids, and you infer, from all
1241 these changes, that no changes had taken place, and that the properties of the material remain unchanged. Am I right?

A. The percentage of free fatty acids which I found, would, in my opinion, account for the slight changes in the appearance of the fat, with the exception of its greater whiteness, which is due to the action of water or other not well-defined substances contained in the fat. A similar action is observed when treated with water under high temperature and pressure.

X Q. 48. You do not answer my question. I did not ask you what caused the changes observed, but as to your inference from the changes; please answer my question with this understanding.

A. It would be impossible for me to draw any inference of the changes which the fat had undergone, without reference to chemical analysis and a knowledge of the facts, by mere external appearance of such fat. The difference is in physical properties, while the chemical properties remain the same. I infer from these changes that the fat is different from what it was before.

X Q. 49. How do you know that the difference is only in physical properties, while the chemical properties remain the same?

A. In my examination for the determination of free fatty acids contained in this fat, I saponified the fat and met with no abnormal behaviour whatever.

X Q. 50. The residue of which you have been speaking was the residue of your second distillation, I understand?

A. It was the residue of the first distillation.

X Q. 51. Did the residue of the second distillation differ from the residue of the first distillation, and, if so, in what respects?

A. I did not examine it chemically. At the time when the second examination was finished I had to leave Prof. Morton's laboratory, and did not see it, therefore.

1242 X Q. 52. You have stated as a matter of fact that the residue of the distillation in which you obtained free fatty acids and glycerine in the condenser without admixture, without neutral fat, and without the production of acroleine was unaltered neutral fat, in so much as it was capable of further and complete distillation into fatty acids and glycerine, and now you state that you never even saw this residue. How do you reconcile these statements?

A. I have never made the statement that I examined the fats remaining in the still from the second distillation.

X Q. 53. Do you mean to say that, in answer to my 46th cross-interrogatory, which was as to the condition of the residue of the distillation in which the separation was "complete," you did not mean me to understand that you referred to the residue of your second distillation experiment?

A. It may appear here that there is a discrepancy, but if we consider that in a chemical laboratory we rarely finish an analysis on one sample, and so in our investigations we made a number of experiments in order to reach a theoretical conclusion, and as in these questions I was asked rather as regards the conclusions I had drawn from my experiments than as to the details of the experiments themselves, I have not hesitated to use the facts elicited from both experiments. I have no doubt that the residue obtained in the first experiment was capable of being made the basis for a complete distillation, if such were practicable, in the manner assumed in cross-question 46. The word "complete" is used in connection with complete distillation, and I understood it in the sense of distillation without residue, which might remain in case of deeper going molecular changes in the mass.

X Q 54. My cross-question 46 was intended to be as to how you know the condition of the residue of the successful distilla-
1243 tion and its capacity for a further similar complete distillation. Now, I understand you to say that because in an unsuccessful distillation in which you did not distill over more than 20 per cent. of the material, and in which the residue was so entirely changed that even at a temperature of 250° C. it continued to give off acroleine, you found such residue to be whiter and harder than the fats used, and to contain 3.7 per cent. of free fat acids, and to be capable of complete saponification with an alkali; therefore your inference is so strong that you are willing to state as a matter of fact that in another experiment in which you distilled over nearly 50 per cent., and in which, at a temperature of 280° C., no acroleine was produced, the residue, which you never even saw, was also whiter and harder, and also contained 3.7 per cent. of free fatty acids,

and was fitted for continuous, complete distillation without the production of acroleine. Please explain how and why you formed this opinion.

A. I have not stated that the residue in the second distillation had these properties. The problem which presented itself in this investigation was simply is the fat volatilized to any extent and decomposed in the shape of vapor, or is the fat volatilized while it is solid and in contact with water in the state of steam. There are two ways in which an answer can be given to an inquiry put, by making a scientific experiment. In the first place, there may be after steam treatment more free fatty acid in the residue, or the distilled product is perfectly free from neutral fats. In the second distillation process the fat acids distilled were perfectly free from neutral fats. The examination of the residue in the still after the first experiment would have also been neglected if the distilled fatty acids had been perfectly pure; but they were not perfectly pure, as they contained neutral fat, and it became of interest to ascertain whether the fat residue contained free fatty acids. If it did
1244 contain free acids, the results might be taken as confirmatory of the theory.

That, in the second experiment, at no time acroleine was noticed, though the experiment was carried over a longer time, must be taken as indicating that the process would continue indefinitely, unless the conditions were changed. I have also stated, repeatedly, that the first experiment did not fail in any other way, but merely in the fact that the distillation was irregular. The original arrangement of the apparatus occasioned a condensation of water in the pipe that connected the superheater with the boiler. When the mass of water so condensed in the pipe was sufficient to fill it entirely, the steam would throw the liquid water into the superheater, and this naturally would cause explosive-like ebullitions of steam. It is a well-known fact that glycerine is a substance which, in the distillation process, suffers first, while the fatty acids are comparatively little changed, unle s the temperature goes above that of melted lead. While, therefore, these irregularities may have been the cause of the decomposition of some of the glycerine, and evidently were, for the apparatus continued to give vapors of acroleine even after the temperature had been reduced to 250° cent., I think it is quite safe to accept, from the results obtained, that the fats are first decomposed and then volatilized.

(The solicitor for complainants objects to further answer in this direction, because not responsive to question.)

The master rules that the latter part of the answer is not responsive, and that the witness should confine his answer to reasons for his opinion, if such be his opinion, that the residue in the
1245 second experiment was of the nature stated in the question, to which rule solicitor for defendants excepts for following reasons:

1. That in his opinion the answer is responsive to the question, and

2. That it is directed to the correction of insinuation and misrepresentations as to the witness' testimony embraced in the recital of the question to which it is made.

3. Because the ruling operates as license of counsel to misstate, misrepresent, and disparage the witness in his testimony, while closing the mouth of witness to any explanation necessary to protect him against such abuse or misconstruction, and preventing him from pointing out such distinctions and stating such facts as are proper and necessary to the understanding of his answers given or to be given.

A. In stating that the fat contained 3.7 per cent. of free fatty acid I did not mean to convey any other fact than that fats under such treatment would become richer in free fatty acids than they were before. If the question, therefore, states that I should adhere to 3.7 per cent. of free fatty acids I consider it unreasonable. I have a very strong opinion that the fatty residue in the retort contained more free fatty acids than the fat originally taken—perhaps more, and perhaps less, than 3.7 per cent. If fat contains free fatty acid we know it will become harder and whiter, and I believe, therefore, that the residue was harder and whiter, unless the fatty acid should be united with some oxide of copper derived from the copper of the apparatus, which is possible, inasmuch as the apparatus had been used for about three hours, and which would give it a tinged cast.

Fat is only to a very small degree volatile, and then only under a considerably-diminished pressure, as, for instance, under an
1246 air-pump. It is, therefore, *a priori* certain that fat must be decomposed first by water into its hydrated constituents, to wit, fatty acids and glycerine, before volatilization is possible.

X Q. 55. In your opinion, what percentage of free fatty acid can be obtained from a given quantity of neutral fat by steam distillation?

A. I have not made a quantitative experiment to ascertain the quantity of fatty acid obtained from neutral fat by this process. It is certain that some of the fatty acids may be lost, as they are in every operation carried out for manufacturing purposes; but, from what I have read, and from the products I have obtained, I am of opinion the loss would not be greater than from 2 to 3 per cent. below the theoretical yield of 95 per cent.

X Q. 56. You are satisfied, then, that a practically thorough decomposition can be so effected; and your opinion is based upon the facts that in the distillation you made you obtained free fatty acids and glycerine and a residue of over 50 per cent., which, in your opinion, would continue to distill like fresh neutral fat?

A. I am satisfied that a thorough decomposition can be carried out by this process, and that opinion is based upon the facts substantially stated in the interrogatory, and also the fact that no by-products of decomposition were observed.

X Q. 57. What proportion of water to fat acid came over into the condenser in your two distillation experiments?

A. The exact proportion was not noted, but the quantity of water

in the distillate was much greater than the quantity of fat acid obtained—about the same in both—four to five times as much.

X Q. 58. In your distilling experiment, when you got less than 50 per cent. of fatty acids and a residue, which you think to have been substantially neutral fat, these results convinced you,
1247 you say, that prolongation of the distilling would result in a practically thorough decomposition; and I understand you to say, in your direct examination, that in your experiments with what you call the Tilghman process, in which you obtained much more than 50 per cent. of fatty acid, and a residue which you knew to be neutral fat, you were convinced that a continuation of the treatment would not effect a practically thorough decomposition. Please say if I am correct; and, if so, how do you explain such contrary deductions from such similar facts?

A. Your statement of the theories I have advanced is correct. It is true that both reactions are practically the same, both resulting in the formation of stearic acid and glycerine. The products of decomposition are, however, in the distillation process, removed from the fat in the retort, while in the Tilghman process the glycerine and fat acids remain with the fat.

X Q. 59. You have stated that, in your first distillation experiment, acroleine continued to be given off at as low a temperature as 250° cent. If this distillation had been continued, do you think the production of acroleine would also have been continued?

A. I believe it would as long as the apparatus worked in the irregular manner I have indicated.

X Q. 60. Did you try the effect of distilling any of the residue of the first distillation in the apparatus after you had corrected its defects?

A. No, sir; the material was divided into two parts; one part I took to my laboratory, and the other was retained by Prof. Morton. The quantity left after the division and examinations would have been too small.

X Q. 61. Did you ever completely distill any given quantity of neutral fat, large or small, so as to leave no residue?

1248 A. I did not do so, and I do not believe it to be practicable, for the reason already stated, that the reduction of the fat in the still would cause certain portions of the still to be overheated, whereby the fat may be decomposed by the heat alone without the contemporaneous action of water. In all such operations it is necessary to keep the fat on a certain level.

X Q. 62. What do you mean by water in your last answer—liquid water or steam?

A. I mean steam.

X Q. 63. Then answer my 61st question with the understanding that overheating is prevented as it was in your apparatus by the constant presence of steam at a regulated temperature and by the anthracine both having its temperature also kept to a regulated degree.

A. If such conditions as the question assumes could be practically had I believe that the experiment could be made.

X Q. 64. Do you consider yourself qualified by your experiments and your reading to giving an opinion as to the economical commercial practicability and value of the steam distillation of neutral fats?

A. In the ordinary sense I do not, but as far as the applicability of the method to produce certain results is concerned I do. In the ordinary sense the economical value would have to be decided by an engineer, while the question of what the method is capable of producing is a question which I have tried to solve.

X Q. 65. Do you or do you not consider yourself qualified to state whether steam distillation of neutral fats is more economical than what is known as the old lime-saponification process, both processes, for instance, being applied to tallows?

A. Inasmuch as both processes produce about the same product I would, in the sense I have given my testimony, consider
1249 them equivalents. As far as the actual cost of carrying out each of those methods is concerned I can see that there can be no great difference in cost; but a more detailed statement I am not prepared to make, as that is the task of an engineer, and I do not consider myself qualified to make it.

(Question repeated and a direct answer requested.)

A. As a business question I cannot answer it.

X Q. 66. Are you aware of the fact that the defendants have in their factory a number of stills?

A. I have seen one still, and heard that another was in existence which was used for the distillation of some residue, but do not know what the residue was.

X Q. 67. These stills are provided with apparatus for superheating steam, are they not?

A. Yes, sir.

X Q. 68. Do you know whether the defendants use or have used them for distillation of neutral fats?

A. I do not know.

X Q. 69. Was the water which came over into the condeser with the fatty acids in your distillation experiments acid?

A. In which experiments?

X Q. 70. State as to both.

A. They were both acid.

X Q. 71. Did you ascertain the amount and kind of acid present in this water?

A. The water in the first distillation had an acroleine flavor. In the second distillation the water was odorless, colorless, and tasteless, but had a slight acid reaction, which was due to some small quantity of fatty acids dissolved in it. On concentration the sweet taste of glycerine was observed.

X Q. 72. Have you visited any other fat-acid works in this country excepting Gross's, in Jersey City, and the defendants' in Cincinnati?

A. I have not.

1250 X Q. 73. Steam distillation of neutral fats was not practiced in either of these works, was it?

A. I could not tell.

X Q. 74. Did you see it or hear that it was practiced?

A. I believe it is not practiced at the present time. In steam distillation practiced at the present time decomposition is aided by the use of some sulphuric acid.

X Q. 75. Did you ever see this sulphuric-acid distillation process in use?

A. Not that I know of.

X Q. 76. Will you please define, as clearly and fully as possible, exactly what you think the Tilghman process, which you have spoken of in your direct examination, to be?

A. The Tilghman patent produces decomposition of fat by water at temperatures above the boiling point of water and under pressure, this decomposition to be carried out either in an apparatus described in the patent or in an apparatus known and in common use at the time, excluding all apparatus the invention of which is later than the Tilghman invention having patentable novelty; also excluding all substances beside those mentioned in the patent and using those mentioned in the patent only for the purpose and in the manner prescribed.

Adjourned until to-morrow morning.

SATURDAY MORNING, *May 19th*, 1883.

Cross-examination of H. ENDEMANN resumed by F. T. CHAMBERS, Esq.:

1251 X Q. 77. Am I to understand by your answer to the last question that, in your opinion, the decomposition of neutral fats into fatty acids and glycerine by means of water under a high temperature and pressure is not an infringement or use of the Tilghman process if it is carried on in a vessel having, for instance, a patented stirrer or a patented stop-cock or pressure-gauge.

A. It would be an infringement of the patent.

X Q. 78. Please explain what you do mean in your 76th answer when you state, as I understand you, that the use of the process described in my last question would not be an infringement or use of the Tilghman process if carried on in an apparatus having patentable novelty?

A. I would consider the use of an apparatus having patentable novelty for the execution of the Tilghman process an infringement of the Tilghman process, and *vice versa*. I would consider Mr. Tilghman to infringe if he should use, or cause to be used, such patented apparatus. If the apparatus possesses patentable novelty, without being patented, I should consider it proper that the merits of the original patent and the modification proposed be respectively considered in reaching a conclusion as to how much is due to the one and how much to the other.

X Q. 80. Do I understand you correctly as asserting in your 76th answer that the use of the apparatus known or used at the date

of the patent is to be considered as contemplated by the patentee, and such use to be an infringement or use of Mr. Tilghman's patented process purely and simply?

A. I believe that such use was not contemplated by the patentee, but the construction given by the Supreme Court introduces the feature into the patent, and any one treating fat with water under heat and pressure in an apparatus known and in use at the date of the Tilghman patent would infringe that patent purely and simply according to the construction given to it by the Supreme Court.

1252 X Q. 81. In reading the exhibits printed in the supreme court record did you read the letter to the Commissioner of Patents, dated August 7th, 1854, printed on page 995, and explaining that the patentee did not intend to limit his process to the use of any form of apparatus or to any degree of heat and pressure?

A. I have not read it so far, but will do so now. Reading this letter, I see that Mr. B. C. Tilghman contemplated, perhaps, the use of other apparatus, which I understand, however, to mean such apparatus as will carry out his process, with the excess in heat and pressure, originally contemplated by him.

X Q. 82. Have you read the testimony of Mr. R. A. Tilghman, on pages 1012, 1013 and 1014, as to his experiments and knowledge prior to applying for his patent?

A. I believe I have, but desire to read it again to refresh my memory. (After reading the testimony witness resumes.) I had read it before, but many details had escaped my memory. I have refreshed my memory now.

X Q. 83. Please explain what you mean in your 76th answer, where you say "also excluding all substances besides those mentioned in the patent?"

A. The decomposition of the fat in the Tilghman process, according to the patent, is to be carried out solely by water, which is to be applied under heat and pressure. Any third substance introduced for the purpose of producing this decomposition is not within the scope of the patent.

X Q. 84. Do you mean that if, for instance, one per cent. of lime is used, together with water, under heat and pressure, that the process is no longer Tilghman's and does not infringe upon his patent?

A. If one per cent. of lime would be required to saturate free acetic acid occurring in the fat, as stated in the patent, the

1253 process would be simply within the patent. Fats, as ordinary tallow, for instance, contain but very small quantities of acetic acid, and the quantity of one per cent. of lime would, in all cases, be more than necessary for the complete saturation of acetic acid, or similar soluble acids of the fatty series. In using one per cent. of lime there would, therefore, always be an excess of lime, which would aid saponification. Under these circumstances, therefore, the process would not be within the patent, pure and simple.

X Q. 85. Any quantity of lime, then, necessary to completely neutralize the soluble acids formed during the process of decompo-

sition would, in your opinion, be properly used under the patent?

A. So much as is required for neutralization, and no more. The patent considers, however, the use of this substance as something exceptional, and something which, under ordinary circumstances, would rarely occur. The words of the patent are: "Some fatty bodies, particularly when impure, generate during the process a portion of acetic acid, or other soluble acid, which might tend to injure the iron tubes. In such cases I add a corresponding quantity of alkaline or basic matter to the water and oil before they are pumped into the tubes." It might appear from the wording of the patent that the patentee considers this precaution necessary only in case where his tube apparatus is used.

X Q. 86. Do you not know, as a matter of fact, that the glycerine water produced in the defendants' works, where they use one per cent. of lime in their process, contains free soluble acid?

A. I do know so; but, if Mr. Tilghman would add such a quantity of lime as to prevent this completely, the Tilghman process would be identical with the old lime-saponification process, and therefore not patentable. Mr. Tilghman's idea evidently was
1254 that acetic acid and other similar acids, being stronger acids than the non-volatile fatty acids, would take possession of the lime, and that the other acids formed during the process would not interfere with this.

X Q. 87. Is it your opinion, then, that Mr. Tilghman is, under his patent, entitled to use alkali sufficient to entirely neutralize all the free soluble acids formed, but is not entitled to use sufficient alkali to diminish these free soluble acids without entirely neutralizing them?

A. Mr. Tilghman could under no circumstances use so much alkali as to entirely prevent the formation of those free acids without forming a neutral soap, and this is not contemplated in the patent. I believe that he is entitled to reduce them in the manner which I stated before.

X Q. 88. Do you know that the glycerine water produced in the defendants' works always contains some soluble lime salts?

A. I do not know this to be the fact.

X Q. 89. And these soluble lime salts are produced by the union of some of the lime with the soluble acids produced from the fats treated, are they not?

A. Yes, sir.

X Q. 90. Have you ascertained the percentage of free fatty acids in the product of the defendants' process, as ordinarily worked by them?

A. I have examined a sample of such product which was handed to me by Prof. Morton, which he stated to me he had received from Procter and Gamble on his application, and that he understood it to be the product obtained in the regular working of their factory. The examination proved that it contained fatty acids, partly free and partly in combination with lime, and also some neutral fat. For the purpose of analysis the lime was removed by means of sulphuric acid. The fat mixture obtained was dried previous to

1255 analysis. The chemical examination showed that 97½ per cent of the mass thus obtained was free fatty acids, and 2½ per cent. was neutral fat.

X Q. 91. Did you ascertain what percentage of lime was contained in this product?

A. No, sir.

X Q. 92. Have you ascertained what percentage of lime or lime salts is contained in the glycerine water produced by the defendants' process?

A. I have not. A single examination would have been of no value, as the amount of lime in solution must differ with every charge of fat, according to its nature.

X Q. 93. You mean, do you not, that this percentage of lime will differ in each charge as the amount of impurities in the fats treated differ, being greatest with the most impure fats, which would produce the largest amount of soluble acids?

A. I mean that the amount of lime will be greatest when such fat is used, while producing the largest amount of soluble lime salts.

X Q 94. Do you not know that, generally speaking, an impure fat will produce more soluble acids than a pure fat?

A. I do not know that, but I do know that some of the purest fats will produce far more soluble lime salts than can ever be obtained, for instance, from tallow.

X Q. 95. Taking any commercial fat, is it not your opinion that tallow, for instance, will produce more soluble acids when impure than when pure?

A. I have made no investigation to that effect and am not aware of any such fact having been published in scientific literature, excepting the statement made by Mr. Tilghman himself in his specification for a patent. I have no opinion on the subject. The fact must be determined by actual experiment.

X Q 96. Do you mean to be understood in your direct ex-
1256 amination as asserting that it is impossible to decompose neutral fats and produce fatty acids fitted for commercial uses by the action of water alone heated under pressure?

A. If the glycerine is not to be taken into account I believe a decomposition reaching such results as stated is possible.

X Q. 97. Do you mean that it is, in your opinion, impossible to decompose neutral fats and produce fatty acids and glycerine, both fitted for commercial uses, by the action of water alone heated under pressure?

A. I know that this process has been carried out, and have no doubt the products found a market; but I also know that it is not carried out any more for the reason that it produces impure fat acids, and that it could not compete with the products of factories working under different plans.

SATURDAY AFTERNOON, *May 19th*, 1883.

Cross-examination of H. ENDEMANN, continued by B. C. TILGHMAN, Esq.:

X Q. 98. What plan do you allude to in your last answer?

A. The old lime-saponification process and also more modern processes—the Bock method, the distillation processes, and the processes which are carried out by means of heated water under pressure and in the presence of lime.

X Q. 99. Do you know of any factory in the United States in which the process of heat, pressure, and water alone was carried on for any number of years on a large scale?

A. I have read in the record depositions of various parties
1257 acknowledging the use of the method—for instance, C. H. Grant; that is the only name I recollect at the present time.

X Q. 100. Have you read in the record any account of the factory of Roland G. Mitchell in or near New York city?

A. Yes, sir.

X Q. 101. Describe his process as you understand it.

A. Please refer me to the page where his description is given.

X Q. 102. Do you mean to say that you have not read in the record any account of the process practiced by Mitchell, and that you do not understand what it is?

A. I cannot tell whether I have read the description of this process. The names of most of the parties given in the record were not known to me, and, though I have made myself acquainted with the various views communicated therein, I could not exactly tell who gave one or the other opinion or described one or the other process.

X Q. 103. Are you acquainted with the precess decribed in the patent to Wright and Fouché, a copy of which is annexed to the record as Exhibit Patent Wright & Fouché, on pages 243 to 246?

A. I am; not by any diagram found in the record, for there is none, but by description found in literature.

X Q. 104. What are the chemical agents used in the process as you understand them?

A. Water, under heat and pressure, acting upon neutral fat.

X Q. 105. What are the products of that operation?

A. It is claimed in the patent that decomposition of the fat into free fatty acids and glycerine is produced. Whether this is a complete reaction—that is, whether all the fat can by this pro-
1258 cess be converted into free fatty acids and glycerine, is, according to my own experiments and some of the exhibits produced by me, not only doubtful, but it is acknowledged that in this manner a complete decomposition cannot be effected. I refer here to Exhibit "Birnbaum," which I presented in the early part of my examination.

X Q. 106. Do you know as a matter of fact that this process by heat, pressure, and water alone has been carried out, on a large scale, by R. G. Mitchell in the Wright & Fouché apparatus?

A. No, sir; I have asked you to refer me to the page.

X Q. 107. I refer you to question 16 on page 749, questions 1, 2, 3 on page 746, and repeat the question.

I see therefrom that Mr. Roland G. Mitchell has used the Wright & Fouché apparatus. It is not stated to what extent this special process has been carried. I find, in his answer to third question,

that about 40,000 pounds of fat per week were saponified, and in answer to question 2 it is stated that part of the time the lime process and part of the time the water process without lime was used. There is no clue as to how long either of these processes was in use. By the manner answer to question 16 is given I would suppose that, at the time of this examination, 1869, this process was the only one used in his factory.

X Q. 108. I further refer you to cross-question 52, same witness, on page 755.

A. The information obtained from this is that Mr. Roland G. Mitchell has manufactured 11,500,000 pounds of fat into fatty acids and glycerine, between 1860 and January 9th, 1868, by the use of the Wright & Fouché apparatus and process, or, in other words, that he has spoiled such an immense amount of fat by means of this process.

Q. 109. Please state the grounds for the assertion in the latter part of your answer.

1259 A. The process is known to carry the decomposition only to a certain extent, leaving always a considerable quantity of unsaponified fat in the acid mixture.

X Q. 110. Can you give any probable reason why Mr. Mitchell continued, in 1869, to spoil 40,000 pounds of fat per week, after his experience during eight years preceding, upon the manufacture of 11,500,000 pounds of fat?

A. I cannot.

X Q. 111. In the process carried on in the Wright & Fouché apparatus, as described in the record, are not heat, pressure, and water alone the efficient agents in decomposing the neutral fats into fat acids and glycerine?

A. I consider, as the efficient agents in the Wright & Fouché apparatus, merely the water at high temperature. The pressure I consider a necessary inconvenience, and of value so far as it would tend to keep the water in a liquid state.

X Q. 112. Referring to page 945, questions 18 and 19, to C. H. Grant, what is said about the quality of the candles made by Mr. Mitchell?

A. The answer to question 19 states that the candles made [by] Mr. Mitchell sell from six to eight cents higher than the candles made by the licensees of Tilghman.

X Q. 113. I refer you to page 947, testimony of Henry Bower, questions 1 to 7. Please state what was his business and what he says as to the purity of Mr. Mitchell's glycerine?

A. The statement is to the effect that Mr. Bower is engaged in the business of refining glycerine; that he has bought glycerine from parties working under licenses from Tilghman, to the best of his knowledge: M. Wer'k & Co., Cincinnati; Proctor & Gamble, same place; Goodwin, Behi & Co., St. Louis, and A. Gross & Co.,

1260 of Jersey City; and that he also bought glycerine from R. G. Mitchell & Co., and that in making bids for good glycerine he gave the preference to the latter firm, running to an extent from 25 to 33 per cent. above that furnished by others.

X Q. 114. Has the evidence to which I have referred you on the record produced any effect on your opinion as to the commercial quality of the fat acids and glycerine produced by Mr. Mitchell by means of the process using heat, pressure, and water alone?

A. If this evidence is not contradicted and no other reasons might, probably, be given for the facts therein stated I should think that, as far as the glycerine is concerned, a better product had actually been obtained. I do not think that, from the price of daily commodities like candles, a deduction of the commercial value of the article can be made, as, in many cases, not the one who manufactures the best article, but the one who advertises most, obtains the custom of the public. Unless, therefore, I am acquainted with the affairs of the firm better than I can be by reading a few extracts I could not venture an opinion. Then, there is also to be taken into consideration that it is not the acid mixture sold in candles, but the acid mixture after further treatment.

X Q. 115. You're of the opinion, then, that Mitchell did not effect a sufficiently complete decomposition of the fat into fatty acids to make his manufacture a commercial success; is that so?

A. If Mr. Mitchell has made a commercial success I do not think it is due to the use of the Wright & Fouché apparatus, which I know does not produce a complete saponification.

X Q. 116. How do you know this?

A. I refer to Exhibit Birnbaum and Exhibit Kraut, "Fat Industry in Glycerine," produced by me. In the Birnbaum exhibit the names of Wright & Fouché are not mentioned, but the pro-
1261 cess is described consisting of the use of water under heat and pressure only.

X Q. 117. Is the above all your authority?

A. No, sir; there are also my own experiments.

X Q. 118. Who is Birnbaum?

A. He was professor of chemistry in the Polytechnic Institute at Carlsruhe.

X Q. 119. Who were Kraut and Stass?

A. Kraut is professor of chemistry at Hanover, and he is editor of the latest edition of the best authority on chemistry in any language, Gmelin's Chemistry. Stass is the author of a Belgian report upon the London Universal Exposition of 1862, published at Brussels in 1863.

Adjourned to Monday morning.

MONDAY MORNING, *May 21st*, 1883.

Cross-examination of H. ENDEMANN continued by B. C. TILGHMAN, Esq.:

X Q. 120. It appears from the testimony that defendants formerly decomposed their fats with 14 per cent. of lime with water at 212° Fahrenheit, and mixing in open vessels, and in their answer they state that they now use but one per cent. of lime with water at a higher heat and mixing in close vessels. Is not the higher heat

given to the water the efficient agent in producing this saving of lime?

A. It is.

X. Q. 121. I understand, then, that one pound of lime and highly-heated water do the work of fourteen pounds of lime with water at 212° Fahrenheit; is that so?

1262 A. This work is only done to the same degree of completeness by an additional step, consisting of the removal of the first water and the addition of the second water. Without this change I do not believe that defendants, by the temperature now used, would obtain such complete decomposition as can be obtained by the old lime method.

X Q. 122. To what temperature do you refer in your last answer?

A. The temperature corresponding to an average working pressure of 150 pounds.

X Q. 123. State, if you know, how long the defendants have been using this pressure.

A. I do not know.

X Q. 124. Look at defendants' answer (page 19 of record) and state what pressure they say they were then using.

A. A pressure of from 200 to 250 pounds.

X Q. 125. I understand, then, that one pound of lime with water heated to a pressure of from 200 to 250 pounds does the work of fourteen pounds of lime with water heated to 212° F., the quantity of water used being the same in both cases, and the same change of water being made in each; is that correct?

A. There exists no necessity for the change of water in the old lime-saponification process. As regards the other process, it is true that one pound of lime will give the water, under the circumstances stated, sufficient energy to carry the process to a successful end. The addition of water in the old lime-saponification process will not aid the process materially. Supposing, however, that it has been done in this case, I believe that in both processes referred to substantially the same result will be arrived at.

X Q. 126. Is not the extra degree of heat given to the water the efficient agent which enables the one pound of lime to do the work of fourteen pounds under the conditions stated in the last question?

1263 A. No, sir. The one per cent. of lime enables the practically complete saponification on account of the high temperature of the mixture.

X Q. 127. Is not the extra high degree of heat given to the mixture the efficient agent which enables the one pound of lime to do the work of fourteen pounds under the conditions stated in question 125?

A. The two agents, heat and lime, cannot be separated. While I might say that the extra amount of heat would give the lime the efficiency, I might, with the same right, say that the lime gives the heat the efficiency.

X Q. 128. Do you mean to state, then, that the heat would give the lime the efficiency without the presence of the water?

A. I do not.

X Q. 129. In chemical manufactures as practiced at the date of complainant's patent, was it not a common practice to use several successive doses of chemical agents to make a thorough separation of substances which could be formed or dissolved by such chemical agents?

(Sol. for defendants objects to this question as irrelevant.)

A. The practice as to mechanically separating substances, by reason, for instance, that in a mixture one would be soluble in water, was at that time well known and had often been resorted to. As regards chemical changes, I cannot at present think of any process practiced at that time whereby a special advantage would have been derived by reason of allowing the same substance to react upon another in successive small quantities, instead of using the amount of chemicals all at one time.

X Q. 130. In the quartation process of separating silver, etc., from gold, as practiced at that date, was it not the common prac-
1264 tice to use nitric acid in several successive doses, so as to extract the last portions of silver and other metals from the gold?

A. It was, and is at the present time. Silver and gold are in this case merely mechanically mixed, inasmuch as the silver and gold retain their respective qualities, the silver being soluble in nitric acid and the gold not soluble. I have referred to this class of operations in my last answer as being well known.

X Q. 131. Do you call the solution of silver in nitric acid a mechanical separation?

A. I call it a mechanical separation by chemical means.

X Q. 132. In this operation is not the metallic silver oxidized?

A. The molecules of metallic silver are oxidized and dissolved, leaving the molecules of gold behind in the shape of a sponge. The gold plays in this reaction no part, but lies entirely inactive. When in a previous answer I have distinguished between a mechanical and chemical separation I expected to be understood by this to mean that chemical separation which is illustrated in the saponification of fats, where both the products of decomposition do not exist in the original substances performed, excepting that the molecular arrangement of the atoms may allow of their formation.

X Q. 133. Am I to understand you to state as a chemical expert that at the date of complainant's patent the device of acting on substances by chemical agents in successive doses to produce a more complete decomposition or chemical action than would be produced by one single dose was unknown?

A. It certainly was not unknown, but in a great many cases it was not recognized; as, for instance, in the so-called distillation process patented by Dubraunfant and described by Scharling. The successive treatment in this case consists in allowing the steam
1265 to act upon the fat, and, though the process is actually a continuous one, it may be considered as consisting of various

stages, as only a certain quantity of water in the state of steam can be present in the still at one time.

X Q. 134. You mean, then, that it was unknown, except in cases where one of the substances was in the shape of vapor or gas?

A. I did not say that and do not mean it.

X Q. 135. Do you mean that it was known in cases where one of the substances was a liquid?

A. I have stated before that I cannot recall now any instance whereby successive treatments were used with greater advantage than one single treatment which is analogous to the reaction of fat with water in the presence of lime.

X Q. 136. In the displacement process and apparatus as used at that date, were not successive doses of liquid chemical agents applied to the same charge of the material to be acted upon?

A. They were, but the processes carried out in the ordinary displacement apparatus are generally mechanical separations, and it is also a well-recognized fact, already well known at that time, that better results were obtained by a continuous process.

X Q. 137. And a continuous process is, in effect, an infinite number of successive doses, is it not?

A. It may be so considered.

X Q. 138. In the old lime-saponification process was not the sulphuric acid applied in successive doses to the lime soap?

A. I do not know whether that method had ever been used at the date of the Tilghman patent. On consulting Knapp's Technology, vol. 1 (1848), I do not knd such a process mentioned, nor do I find it in Campbell Morfit's treatise on "Soap and Candles," published at Philadelphia, 1856, on page 442 of that work, wherein the decomposition of lime soap by sulphuric acid is treated.

1266 X Q. 139. Have you inquired of practical manufacturers, the defendants for instance, on this point?

A. I have not done so.

X Q. 140. I read from Morfit's treatise, which you have cited, page 452: "Purification of the block. The press cakes, on being emptied from the bags, are thrown into a very clean lead-lined cedar tub and the whole batch melted by a current of steam. Five pounds of sulphuric acid, diluted with ten pounds of water, are then gradually added to the melted fat block so as to withdraw and precipitate any remaining alkali or other impurities." What do you understand to be the alkaline impurity referred to?

A. Lime, which is present in the form of lime soap.

X Q. 141. This proportion of lime soap must have escaped the action of the sulphuric acid previously applied, must it not?

A. It must.

X Q. 142. And this second dose of sulphuric acid was used to effect the more complete decomposition of the fatty mixture, was it not?

A. It was.

X Q. 143. If one hundred pounds of neutral fat, one pound of lime, and fifty pounds of water are put in an open vessel and heated by an injection of steam to 212° Fahr., and mixed during six or

eight hours, and then the water is drawn off and a new dose of water is added and heated for another six hours, about ten pounds of the fat would be converted into lime soap and about ninety pounds will remain neutral fat. Is that correct?

A. I have never made this experiment.

X Q. 144. And your chemical knowledge on this subject is not sufficient to enable you to answer it. Is that so?

A. That is so.

X Q. 145. Have you any opinion on the subject?

1267 A. I have no opinion on this subject at present, and I believe that the proper way of settling the question would be by a practical experiment.

X Q. 146. Suppose the treatment of a second dose of water was omitted, from the conditions stated in question 143, could you then answer that question?

A. I could not, positively, without making the experiment.

X Q. 147. Can you state the probable results?

A. I have stated in my direct examination that water heated to 165° C., and under pressure, acted upon fat in such a manner that within six hours about 62 per cent. of free fat acids were formed; the experiment carried out under the identical conditions, excepting the addition of 1 per cent. of lime, yielded a fat mixture containing 84 per cent. of fat acids. This 1 per cent. of lime had, therefore, been the cause of the formation of an additional 22 per cent. of free acids. Experimenting under higher pressures the quantity of fat acids formed by reason of the presence of lime was found proportionately smaller. There is, therefore, no regular increase, and operating at other temperatures is liable to elicit facts differing from those stated.

X Q. 148. You mean, then, that you are not able, from experiments at a given temperature, to draw any conclusion as to what will happen at any other temperature?

A. If the temperatures were near together I might venture an opinion, but as the temperature named in the question differs considerably from the temperatures at which the experiments were made I do not venture an opinion.

X Q. 149. Then your knowlenge of this branch of chemistry is not sufficient to enable you to form an opinion as to whether boiling neutral fat in an open vessel with water and one per cent.

1268 of lime would form a quantity of neutral lime soap equivalent to the lime used?

A. I am not aware that such experiments have been made, and my knowledge, therefore, is not sufficient to enable me to form an opinion.

MONDAY AFTERNOON, *May 21st*, 1883.

Cross-examination of H. ENDEMANN continued by F. T. CHAMBERS, Esq.:

X Q. 150. Do you know when the process known as the sulphuric acid distillation process went into use?

A. I cannot give the exact time; some time between 1840 and 1850, the earliest patent being taken in the year 1842.

X Q. 151. Is this process still in use?

A. I have never seen it in practice, but I understand it is still in use.

X Q. 152. What is the product of this process?

A. Fatty acids and glycerine; at first very large quantities of sulphuric acid were used, resulting in the destruction of a considerable quantity of glycerine. Gradually, however, the amount of sulphuric acid used in the process was reduced, and thereby a large yield of glycerine was obtained. I think they used at one time as much as 15 per cent. of sulphuric acid, but it was reduced to about 5½ per cent, in 1850 to 1851, and now only from 1 to 2 per cent. is used.

X Q. 153. What authority have you for stating that, in the present process, but 1 or 2 per cent. of sulphuric acid is used?

A. I have read it somewhere, but cannot give the reference
1269 now. The lowest I can now refer to is in the report on the Vienna Exposition of 1873 (reprint of 1877), vol. 3, page 497, which reads: "Already, in the year, 1862, Roubaix, Jenar & Jansens, in Cureghem, near Brussels, used a method of rapid saponification like the one which bears Milly's name. To this end 3¾ to 4 per cent. of sulphuric acid, heated to 100° C., are run slowly into a mixture of equal parts of tallow and palm oil heated to 110° to 115° C. The mass is stirred for ten minutes and allowed to settle."

X Q. 154. Do you know what percentage of fatty acids were obtained from the fats treated by the sulphuric acid distillation process?

A. According to an experiment made by Stass, 89½ per cent. of acids were obtained from tallow.

X Q. 155. Do you know what the practical experience has been when the process was employed on a manufacturing scale?

A. The fat acids which could be obtained average from 86 to 89 per cent., but the yield of material for candles has always been acknowledged to be greater by the distillation process than by the lime-saponification process. Thus it is stated in the report on the Vienna Exposition for 1873 (reprint of 1877), vol. 3, page 498, that the same fat on being treated in a digester with lime, yielded from 45 to 48 per cent. of commercial stearic acid, as used for candles, while the sulphuric acid distillation process yielded from 55 to 60 per cent. of the same material.

X Q. 156. Is it not the fact that the sulphuric acid distillation process is used in this country almost exclusively with fats too impure to be successfully treated by either lime saponification or the Tilghman method?

A. I have no experience in regard to this subject.

X Q. 157. You know, do you not, that the defendants, when working with impure fats first decompose them in the manner
1270 described in their answer, and then distill the fatty acids thereby produced in a current or superheated steam?

A. I know that the defendants distill, but do not know what the raw materials are which they distill.

X Q. 158. In giving your testimony as to the want of practicability of the Tilghman process for use on a manufacturing scale, did you have in view, and did you have any knowledge of, the fact of R.G. Mitchell's successful use of this process on many million pounds of fat?

A. I did not have it in view. In the testimony laid before me, and which I read on Saturday, nothing is said of the purity of the first fat acid mixture obtained; nothing of the additional treatment which was required to obtain a material for candles. I am, therefore, by no means convinced that the first product obtained by this process possesses such purity that the working of the process will secure advantage. The experience had in Europe of the use of this process, in my opinion, seems to prove that it is not an advantageous one. The process was carried out in the Wright & Fouché apparatus, which, according to Stass, has also been used by the Vienna manufacturers.

X Q. 159. You have put in evidence a number of extracts from books and papers. Are you willing to swear that these extracts accurately and fully embody the meaning and substance of the authors in the papers from which they are extracted?

A. They do.

Re-examination by R. H. PARKINSON, Esq.:

R. D. 1. Have you read over your direct examination since written out by the stenographer? If so, are there any corrections you desire to make?

A. In answer to question 16, I stated the amount of fat and water were in equal proportions. The amounts really used were
1271 fat, 500 grammes; water, 1,000 grammes. In answer to question 40, I stated: "I believe these are all the methods." Some of the methods having been accidentally omitted, this statement is incorrect.

R. D. 2. Would there, in your opinion, be any difficulty in continuing the process of saponification by distillation, provided a sufficient quantity of fat was kept in the tank by supplying the deficiency from [time] to time, so as to prevent the supply in the tank becoming exhausted?

A. I cannot see any difficulty, but, on the contrary, would consider that the proper way of working it—to carry on the process for a week or two, and then to clean out the still and commence again.

R. D. 3. Referring to cross-questions 86 to 88, is the free soluble acid referred to therein acetic acid?

A. I have never met with the characteristic odor possessed by acetic acid whenever I saw glycerine water evaporated.

R. D. 4. Referring to answers to cross-questions 129 and immediately following, do you use the term "mechanically separating" as referring to the agent by which the separation is effected or to the kind of relation from which the parts are released?

A. The kind of relation from which the parts are released.

R. D. 5. Referring to cross-question 97, when you say "I know that the process has been carried out," do you refer to any knowledge of that process having been carried out practically other than what is obtained from the record of this case?

A. I speak here with reference to a process which has been carried out independent of the completion of the decomposition, and with reference to the record in this case. I have referred to a number of exhibits wherein it is stated that water has been used under heat and pressure and a satisfactory result could not be obtained.

1272 R. D. 6. Have you or have you not any personal knowledge of this process having been practically carried on—that is, any knowledge outside of what you derived from the record in this case and the exhibits you have produced?

A. I have not.

R. D. 7. Referring to the extract from Morfit's treatise quoted in cross-question 140, do you understand this to refer to successive introduction of installments of sulphuric acid in the same treatment or a subsequent introduction of sulphuric acid after an intermediate treatment?

A. I understand it to be the treatment of the substance which, previous to this treatment and subsequent to the first treatment with sulphuric acid, had undergone additional treatment.

R. D. 8. Referring to cross-question 58, can you give any familiar illustration of the difference in respect to the continuation of reaction where the products are carried off and when they remain in the same vessel?

A. If I mix acetic acid and alcohol in equivalent proportions they will react upon each other, forming acetic ether and water. This reaction will continue until sufficient water has been formed to prevent its continuation. If, however, we take the precaution to remove this water, by reason of its chemical affinity to other substances, the reaction can be completed. This principle lies at the foundation of the manufacture of ethers, especially of the ether just mentioned, and is an illustration that by the removal of a substance which is the product of the reaction the reaction can be carried out to the end.

H. ENDEMANN.

It is hereby agreed and stipulated between counsel that the above list of extracts, numbered 1 to 12, be marked by the master as
1273 exhibits, and used for and instead of the books referred to, the translations made by the witness not being finally accepted as correct, but being subject to correction by duly qualified witnesses produced by complainants; and it is further agreed that the complainant may introduce translations and further extracts from any of the books referred to and use them at the hearing with the same effect as if the whole volume had been offered in evidence by defendants, it being understood that any further translation from books in a foreign language be submitted to defendant's counsel at least six weeks before the hearing, and in case of any disagreement

as to correctness of translation the master be requested to select a translator, whose decision shall be final; and, further, that the witness shall translate and append to his deposition any further extracts from said volumes referred to on cross-examination.

Hearing May 22nd, 1883, 11 a. m.

JOHN W. HILL, called for defendants, being duly sworn, testified as follows:

Examined by Mr. PARKINSON:

Q. 1. State your name, age, residence, and occupation.

A. My name is John W. Hill; I reside at Maplewood, Ohio; am 34 years of age, and a consulting mechanical engineer by occupation; my office is located in Cincinnati.

Q. 2. What experience, if any, have you had in examining
1274 and testing mechanism? What opportunities of becoming familiar with the mechanical arts, and with the investigation of questions concerning the mechanical construction and operation of devices used therein?

A. I have been engaged continuously for the past 20 years as a mechanic, as a superintendent of manufacturing establishments, as consulting engineer to manufacturing establishments, and for the past eight years professionally as a consulting mechanical engineer. During this time I have investigated the performance and operation of a great many machines, but particularly in the line of steam and hydraulic machinery, being at the present time consulting engineer of Mr. William A. Harris, of Providence, Rhode Island, manufacturer of the "Harris Corliss" engine; E. P. Allis, of Milwaukee, Wisconsin, builder of Corliss engines, and frequently as consulting engineer to the Holly Manufacturing Company of Lockport, New York, builders of pumping machinery, and also to cities as consulting engineer in the matter of pumping machinery for public water supply, and during this time I have filled quite a number of public engagements. For the Cincinnati Industrial Exposition of 1874 I was chief of experts, having in charge the testing of steam and hydraulic machinery. For the exposition of 1875 I was again chief of experts for the tests of steam and hydraulic and other machinery. For the Cincinnati Industrial Exposition of 1879 I was chief expert for tests of furnaces and boilers. For the Millers' International Exposition of 1880, held in this city, I was chief of experts for the tests of steam-engines; and I have filled professional engagements, making contract trials on pumping-engines for the cities of Peoria, Memphis, Evansville, Dayton, Buffalo, New York, Saratoga, and Milwaukee.

Q. 3. Examine the Mr. R. A. Tilghman patent here in suit, and state whether you have read and understand the same.

1275 A. I have read the patent of Mr. R. A. Tilghman, to which my attention is called, and I believe that I understand the meaning and intent of the same.

Q. 4. Have you ever constructed, or assisted in constructing, any apparatus for carrying out the process therein set forth; and have

you ever used such apparatus in the operation of such process? If so, please state the facts fully, giving the time and place.

A. I was called upon by Mr. James N. Gamble, of the firm of Proctor & Gamble, last October—perhaps the middle of the month; I cannot remember the exact date—to examine a coil apparatus which had been built under his direction, and which had been erected and had broken prior to making any experiments with it—I mean making any experiments with fats. I examined the coil and gave him an opinion as to the probable cause of breakage, and was then employed by Mr. Gamble to develop a new coil, the instructions being to make it as nearly in accordance with the description of the apparatus given in Mr. Tilghman's patent, together with the testimony that Mr. R. A. Tilghman himself gave, and to be found in the back part of this record.

By Mr. CHAMBERS:

Q. Suppose you identify that testimony—point out where it is.

Witness continuing:

A. It was the deposition wherein he described the apparatus necessary to do the work of a soap factory here. This is it, beginning on page 1003. The size of the coil was based upon the answer to question 14, to be found on page 1015, Mr. Tilghman saying: "The coil apparatus used by Professor- Booth, Rodgers & Bridges
1276 was 80 feet long, of tube one-half inch in bore, and it decomposed sixteen pounds of fat per hour;" it would, therefore, require 6¼ times this length, or 500 feet of such tube, to decompose 100 pounds of fat per hour. The amount of tube, though, 500 feet and two or three inches, would represent, according to the specification, a larger decomposition than 100 pounds an hour; and, after determining that it should be 500 feet in length, we then adopted the language of the specification, that the emulsion should be ten minutes in transit through the coil. In the specification the description is that the apparatus shall be so worked as to allow the emulsion to be exposed to the temperature and pressure for a period of ten minutes within the coil; in other words, ten minutes is required to deliver a given quantity represented by the volume of the coil itself, in its heated shape, as we took it through the coil; or, perhaps, a little clearer would be to say every ten minutes during the operation of it we should discharge one coil full, and, as this coil represented 1,200 cubic inches, our discharge was fixed for 1,200 cubic inches for every ten minutes. Now, Mr. Tilghman says, in his testimony, in answer to question 14, on page 1015, I believe it is, that that sized coil would work 100 pounds an hour, which is at variance with his specification; because, if it worked 100 pounds an hour, it would be exposed to more than ten minutes in the coil and be subject to some of the objections that he notes—one is the possibility of burning, I believe, if it is exposed too long; and we therefore adopted the terms of the specification, which was ten minutes to discharge a quantity equal to the internal volume of the coil—that is, so much of the coil as was located in the furnace—and we

have termed this a coil capable of decomposing 133 pounds of fat per hour. That is anticipating, however, somewhat. Mr. Gamble instructed me to develop a coil, obtain the best information I
1277 could as to the manner in which it should be built, and comply with Mr. Tilghman's instructions as closely as we could. The size of the coil was adopted as suggested in the answer heretofore, and was constructed in accordance with the drawings, which were made by my draftsman under my instructions, and which I have here. There are two, one of the coil, and another of the manner in which it was set.

(The drawing now referred to is put in evidence, marked "Defendant's Exhibit, Proctor & Gamble, Tilghman Coil, No. 1.")

The proportions upon which this coil was developed were taken from the specifications as far as it furnished any information and, beyond that, from the drawing which is attached to the patent, the drawing to be found facing page 10 of the record. Now, there is one variation from the construction of this affair that was made which, at the time and as yet, I deem of no consequence as affecting the result, and which is the manner of taking the pipes out of the coil. Mr. Tilghman shows in his drawings the trunnions at opposite corners, diagonally, the inlet pipe being in one corner, and the outlet pipe at the opposite corner. It will be more mechanical and be stated a little clearer to say by placing the trunnions in the center of the width of coil, and by bending the inlet pipe around to the first outer section; by placing the outlet trunnion in the center of the coil and bending the outlet pipe around from the last inner coil. That is the only variation that was intentionally made from this drawing, and that was done because it was more mechanical and would not interfere with its operation. It was erected in a furnace that was constructed substantially after these proportions—the drawing of which I have here.

1278 (The drawing referred to here offered in evidence, marked "Defendant's Exhibit, Proctor & Gamble, Tilghman Coil, No. 2.")

The first drawing is on a scale of three inches to the foot, and the last of an inch and a half to the foot. The total height of the brick-work is a trifle under seventeen feet—that is, from the ground to the crown of the setting. The holes for determining the temperature were located in the top of the coil, about in the positions as shown on the drawing. They were each drilled three inches deep, and about one-half inch in diameter, and tapped for three-eighths pipe. They were then charged with the several materials, after having first dropped a wire into them, and the congelation of the metal about the wire held it in. These extended up through the pipes to a position where they could be handled with some comfort, alongside of the outlet to the chimney. The connection of the furnace, or of the setting with the smokestack, is not shown in this drawing, because there was some little doubt as to how we could utilize a chimney they (P. & G.) had there. It was uncertain as to

whether the connection would be made at the top of the setting or from the side near the top. After the setting was made, however, I discovered that we could utilize the chimney and still make a connection with the top of the setting, which was done by means of a sheet-iron funnel, with a butterfly damper in it, the damper being arranged to work from the firing floor, by means of pulleys and wires. There are some points in detail, of course, that should be made clear, because they vary slightly from the directions Mr. Tilghman has given in his specifications. One I have already explained—in locating the trun-ions opposite each other and bending the inlet and the outlet pipes to suit their positions, believing the only effect it would have would be to add a foot of pipe to each side of the coil.

1279 The decomposing coil contains, by measurement, five hundred feet and two or three inches, as measured after it was put up, exclusive of the inlet and outlet connections. In each trun-ion there is cast a right and left coupling, which joins the inlet and outlet connections to the coil. Now, this measurement of five hundred feet and a few inches does not include the connections outside of these couplings. Now, the joints—of which there were twenty-eight used, twenty-six in the coil and two in the trun-ions—are made strictly in accordance with the sketch shown here, which is a section of two abutting pipes and the right and left couplings, and is known as the "Perkins" joint. This is indicated in Mr. Tilghman's specification as the "Perkins joint," although it is not described, and the description of it is taken from Mr. Perkins' patent, a copy of the drawing of which, I believe, I have in a package here. This is what we understood by the Perkins joint, — meant by Mr. Tilghman in his specification, and what was adopted. The specification calls for a separation of the coils of about a quarter of an inch. When we came to the construction there was some doubt in my mind, as well as in the mind of the piper who built it, as to whether we were not liable to split our couplings if we made them so thin as a quarter of an inch—that is, in the screwing process with the pipe-tongs, and we then concluded that it would be safer, having in view the perfection of the coil, if we could make it so as to make the separation about five-sixteenths of an inch, which is one-sixteenth of an inch more than Mr. Tilghman elected. After this coil was completed in the shop, and all the joints were made tight, the specification stated it should be proven to ten thousand pounds. We had no exact facilities for determining ten thousand pounds, but we purchased a Schaeffer & Budenberg hydraulic gauge, which was graduated to ten thousand pounds, and which we loaded to nine thou-

1280 sand pounds. The gauge was injured in the transaction, but we believed we had nine thousand pounds pressure upon the the coils, and, under that pressure, the thing was absolutely tight. There were no leaks; every joint seemed to be as perfect as though one pipe had been welded to the other, so far as the simple pressure was concerned. After the coil was taken to the foundry to have the cast iron poured about it, in accordance with the Tilghman specification, it was found not to be strictly true in width at opposite ends. It would vary, perhaps, one-eighth of an inch, and then it was a

trifle twisted. We declined to cast it in that shape, and an effort was made to draw it into shape, and then the flask and the patterns were made; the pattern being made by fastening a ¾-inch board to the coils, in the sides and in the top and bottom, due regard being had to draught, to get those pieces out of the flask, and these were everywhere substantially three-fourths of an inch thick, except in those cases where the pipe may have been sprung in a trifle, and then it might have been a little thicker. I may say here that this was the most difficult piece of pipe work that I have any knowledge of in twenty years' experience. That was to explain to you why these pipes were not strictly straight; they were perfectly straight when we started with them, and the effort was made to make them as exact as skill could do it, but the thing would turn around, like a refractory woman. In order to make you familiar with all the details of it as I now remember, I will state there were some variations of that sort where the pipes were not strictly true. However, the effort was made to make them as exact as they could be made, and I believe the thing was so made. Now, after the flask was rammed up and the mold completed, and preparatory to casting the coil, it had been decided that we would put steam of 100 pounds pressure in the coil, and we had already determined—that is, the founder and myself—that it might 1281 be pumped in from two to three minutes, during which time we believed the coil in the joints would not be affected by the molten cast iron. Now, just preparatory to casting it the first time the mold was made it was discovered that some dirt had got into it. What that dirt was, or how it got into it, no one has been able up to the present time to determine; but it was there, and it prevented the free passage of steam through it, and after measuring the head required to drive water through it, I knew the coil was clogged, and it was then taken out of the mold, brought to the pipe shop, and each one of the three sections removed—that is, the two joints joining them were broken. One section was found to be entirely clear of obstruction, and passed water freely; one section seemed to be entirely closed under a pressure of forty pounds from the city mains, and the remaining section vented water very slowly under this pressure. Those two sections were dismantled, after ascertaining as nearly as possible by heating the coil with steam from the opposite ends and locating as nearly as we could the particular section where the obstruction was located. That was then removed and the matter blown out, which seemed to be a roll of paper or waste, of course of the diameter of the coil, which was half an inch, and perhaps an inch and a half or so long. Those sections were cleared, and the joints were then made up again and the coil straightened up as well as we could. It was then proved again, twice, upon two successive days, to 5,000 pounds pressure. The reason why we did not make the load more than 5,000 pounds was because we had had a sad experience with one pressure-gauge, and we proposed to limit the strain this time to what we believed the gauge would bear with safety, which was about half of the load to which it was graduated. It was then taken back to the factory and the flask rammed up again—

that is, the pattern boards fastened around it again, tops and
1282 sides, and the pattern for the trun-ions and for the backet brace which joins the trun-ion to the casting of the coil proper. The flask was then rammed up and it was poured, some three minutes time being required to pour it. A steam pressure of 100 pounds was on, the steam being turned into a cask of water. After the casting was made it was allowed to cool, after taking off the cope during the night, and the next morning I examined it and found it—at least in external appearance—a very perfect piece of work, a very much better casting than either the molder or myself believed we could obtain. Moreover, we knew, from the amount of metal which the coil contained, that the filling between the pipes was reasonably perfect, because it weighed actually a trifle more than what it would be by calculation from the known specific gravity of the iron that was employed. The coil had been weighed; then, after the casting was completed, we weighed the entire mass, and from the gross weight subtracted the weight of the wrought-iron coil and the remainder was the amount of cast iron that was in the coil. The comparison of the net weight with the weight due the volume and the specific gravity of the metal showed the former to be somewhat greater. I have a memorandum to show about what it was. So we made this comparison to assure ourselves that this had run complete, knowing that it was necessary that the spaces between the pipes should be filled with the metal, and we were anxious that they should be in making it. Prior to pouring the metal in the flask this coil had been heated for hours, until it was perfectly dry and was at a temperature approximately of 220°. This I judged by feeling it with my fingers, and with my experience in touching hot steam-pipes I should guess the temperature was at about 220° on the surface of the pipe; of course the steam then was at about 330°. The coil was
1283 then taken to Procter & Gamble's establishment in this city and erected in accordance with the drawing which was offered in evidence, with no variations from that drawing that I am aware of, except the addition of the nozzle in the arch at the top to connect with the smoke-stack, and that nozzle was approximately 20 inches in diameter. The pipe used in the construction of the coil was that selected by Mr. Tilghman in his specification—that is, one-half inch internal diameter and one inch external diameter, and is what is known in the market as extra strong hydraulic pipe. The coil, after being set in the furnace, was connected upon the inlet side with a single-acting plunger pump, the plunger of which worked through a cup leather, and with as short a distance as we could conveniently make it between the pump and the coil—perhaps four feet in the whole length of the pipe—and this pump was connected upon the suction side. (The pump plunger was a three-quarter inch single-acting plunger pump, and the stroke was five inches.) I am depending upon memory now.

(Witness refers to a note book.)

I remember the diameter; that is exact. I have the exact dimensions now. The three-quarters of an inch is right, because that was

a special order to make the plunger of that diameter; but otherwise we took a stock pump of the John H. McGowan Pump Company's make. The diameter of the plunger was three-quarters of an inch and the stroke six inches. The suction side of the pump was connected with a barrel, located upon the floor above, into which the combined fat and water was to be poured, and the scales were provided for weighing the matter into this barrel; then the discharge side of the coil was connected with a condensing coil. I presume the length of pipe between the decomposing coil and the condensing coil was possibly 36 or 37 feet. The discharge after it had
1284 passed the decomposing coil, then rose about 20 or 21 feet, and then passed over upon the tank horizontally some 16 or 17 feet. The diameter of the discharge pipe from the decomposing coil—that is, the internal diameter—was one-half inch to a joint located 27 or 28 feet lineally from the discharge side of the coil; and from that to the condensing coil it was five-eighths of an inch internal diameter. Now, the exact dimensions of the condensing coil I have a memorandum of, but that had been built by Proctor & Gamble before I was employed in the matter, and I cannot determine from memory exactly what the dimensions of it were. At all events, it was arranged with a cold-water inlet and suitable cocks to regulate the delivery of water to it, whereby we could regulate or control the temperature of the product as it passed from the safety-valve. Now, I have here the dimensions of the condensing coil—the pipe was five-eighths of an inch internal diameter, one inch external diameter, and double extra strong hydraulic pipe, and was 93 feet and 3 inches long. The diameter of the coil—the diameter of the circle within this pipe or coil was 32 inches—that is, the inside diameter of the coil. The outside diameter would be 34 inches. It had been coiled on a 32-inch drum. From the outlet of this condensing coil, or to the outlet of this condensing coil rather, a safety-valve was attached; it was an ordinary lever safety-valve with a steam metal plug with an opening of about five-eighths of an inch through the seat, and was loaded with a Salter spring-balance—that is, the type of spring-balance in general use for loading safety-valves to-day. Between the safety-valve and the condensing coil a T was inserted, to which T we attached the hydraulic guage previously used in testing the coil. Now, that is in general terms the apparatus as it was completed. Casks were provided to catch the product as it came from the safety-valve.

That, together with a churn that we had, consisting of a
1285 grease barrel which, in use, was about half filled with the emulsion of the fat and water, and two churn-dashers worked by men, and the scales for weighing the charges of water and fat to this churn, completed the apparatus. Of course, the fat was kept warm. The barrel was merely an ordinary grease barrel, a 42-gallon barrel. I should imagine the dimensions of the barrel were 23 inches at the bilge and from 36 to 38 inches high. During the time we worked the apparatus it was kept from one-third to one-half filled, and these two churn-dashers were worked continuously by the men, two churn-dashers in one barrel, one each side. There was a steam-

pipe in this barrel also to keep the emulsion fluid, a small three-eighths coil that had been set in there, and that was put around the bottom to keep it fluid, and then they did their churning. The churn-dashers were rectangular affairs, and these men were instructed to keep stepping around the barrel in churning, and they worked it as fast as they could. The plates of the dashers were solid sticks about three inches wide and twelve inches long, with hickory handles about five feet long. They were substantially alike. The reason that we used those dashers was that an effort had been made to drive a large ordinary churn-dasher with holes in it with a steam-engine, but it was surprising the amount of power that thing took, and it could not be worked by men fast enough to maintain the mixture, and so these separate dashers with a man to each were adopted. Then the fat itself was kept fluid, or in a melted state, by a coil in a separate cask. There was a cask of fat stock and there was a steam coil in that, and it was kept sufficiently fluid to ladle it out well in weighing it. The diameter of the pipe connecting the churn with the pump was one inch, and the length was 13 or 14 feet. I believe that there was an inch pipe quite up to the suction side of the pump, and we
1286 put on a flange that had been bored and tapped for an inch pipe to unite with the flange on the suction side of the pump. You see there were some details of that sort, which the pipe-fitter was given general directions to make as good as he could down there, and to give the pump every advantage that he could.

(Complainant's counsel calls the attention of the witness to the fact that the figures in his answer do not correspond with the drawing and the figures upon it as to the dimensions of many of the parts.)

Recess taken until 3 p. m.

Hearing May 22nd, 1883, 3 p. m.

Direct examination of JOHN W. HILL continued:

(Mr. Chambers here read to the witness the concluding paragraph of the forenoon examination. The witness then continued:)

Since I left I have gone back to the office to get these pieces that were there, and I find that the testimony is substantially correct, and the error is in the drawing. I want to use as an exhibit this spreader, which determines the separation of the pipes from out to out, and measures somewhere between three-eighths and five sixteenths of an inch.

The spreader referred to is offered in evidence and marked "Defendant's Exhibit Spreader." This was meant to be five-sixteenths. One of them measures a little more than that and the other exactly that. When brought together the couplings will lay
1287 right against the next pipe; and this is a new drawing, Proctor & Gamble, Tilghman Coil, December 22nd, 1882, and the one which the piper used in making the coil. The drawing referred to is offered in evidence and marked "Defendant's Exhibit, Proctor & Gamble, Tilghman Coil, No. 3."

The intention was to make these spaces five-sixteenths of an inch, and that pattern was intended to so represent it, and it does to some extent. Those that are wider are perhaps a 32nd wider, and the error in the drawing is the error of the draughtsman in reproducing the coil. This, however, represents the work of the pipe-fitter, and represents the actual coil. I want to use these couplings and pieces of pipe also as an exhibit; they fix dimensions with a great deal of precision. This was a piece of the pipe that was used, giving the internal bore and the external diameter and the pitch of thread; and this is a right and left coupling, such as was used in making the joints in the coil. There is a burr on that now; those, of course, were filed off.

The parts referred to are here offered in evidence and marked, respectively, "Defendant's Exhibit Coil Pipe," and "Defendant's Exhibit Coupling."

The coupling is not a complete Perkins joint, because it lacks the opposite or abutting piece of pipes, the end of one of the pipes entering into the Perkins joint being faced flat, as the exhibit shows, and the end of the opposite piece being chamfered from the outside and from the inside to make a reasonably acute edge in the center of its thickness. The angle that we adopted in this particular case was 45 degrees, and one section of the pipe having a right thread, the opposite section a left thread, and the opposite ends of the coupling being provided with right and left threads, when the two pieces were run into the couplings and forced together, the sharp edge of one pipe was forced into the flat surface of the opposite pipe.

1288 Q. 5. To what use did you put the apparatus you have described? Please state any experiments you have made with it, giving particulars.

A. The apparatus was completed and subjected to an experiment on the 24th of March of the present year, and after it had been heated up through a period of twenty-four hours, I suppose gradually, and then had water pumped through it for several hours, we then began to pump a mixture of fat and water through, the proportions being adopted, as a mean—that is, the weight of fat delivered for every ten minutes was one-sixth the quantity per hour—that is to say, one-sixth of 138, which would be twenty-three pounds. The arrangement was made to charge the cask containing the emulsion, where we did the churning, with twenty-three pounds of fat every ten minutes, and with ten and one-fourth pounds of water, the water being, as stated in the specification, in bulk from one-third to one-half the fat. We established a mean—we took five-twelfths the bulk of fat, which is half way between the two extremes. Mr. Tilghman mentioned ten and one-quarter pounds to produce five-twelfths the bulk of twenty-three pounds of fat at normal temperature. We first charged the cask containing the emulsion to its capacity, to perhaps the bilge, or something below the bilge, with a uniform number of charges of water and of fat, the charges being weighed in prior to beginning the experiment with the fat. Now, the coil was heated meanwhile, cautiously, until we reached the melting point of tin, or

perhaps a trifle below it. When the wire we had in that hole began to loosen a little, showing it was approaching that point, we began to pump the emulsion through the coil. That experiment only lasted a half hour, when we broke the pump. In the first place, the cup leather which the plunger of the pump worked through gave out, and closed the experiment at that particular time. We
1289 afterward discovered that this particular coil had broken somewhere during this thirty minutes use of it. This is the first experiment and wound up disastrously, as we had run thirty minutes when the cup-leather broke, and we were thus unable to supply the coil, and then, subsequent to the breakage of the cup-leather we found that the fat was going out of the coil through the casting into the fire.

I should have stated that two days before this—which would have been the 22nd of March—or three days, perhaps, I tested the coil after everything was completed to 2,800 pounds at the safety-valve, and we could not discover a leak; it was perfectly tight, and the pressure would stand at about 2,800 pounds for hours during the time I was there, which was two or three hours, and we were able to maintain it at about that figure and I believed it was absolutely tight & against leakage.

After all connections were made throughout then it was fired up, as I have already stated, during the period of twenty-four hours, but after the pump had broken, on the 24th of March, we discovered that the fat was in the fire, and I had some of the brick-work cut away so that we could get in and see about where it was, and it seemed to be venting through the pores of the cast iron opposite the trun-ion where we introduced the emulsion. The first discovery of that leakage of fat through the coil was by the fireman, who, when he was instructed to open the fire door and diminish the temperature, saw this dropping into the fire and flashing up, and then an examination was made and we found it exuding from two points upon what we would term the inside face of the coil—the coil opposite the fire door—and that must have occurred during the latter part of the trial, because we suddenly discovered that our fat was coming out of our barrel very quickly, and none coming out of the safety-valve. The first move after that, and after locating the cause of the trouble, was to put the pump
1290 in as perfect a condition as we could, undertaking to make it competent to pump this hot grease, and we made up our minds that we had this grease too hot in going through the pump. We had to keep it fluid or the pump would not work it at all, and in order to do that we kept the suction-pipe warm by a spray of steam that was playing on it, and the hot grease seemed to be too much for the leather, and it gave out, although it was a new cup-leather that had been introduced just before we went into the experiment, and had not been used more than two hours before it broke. For an hour and a half before we began to pump the emulsion through the coil, the coil was supplied with water under pressure of approximately two thousand pounds at the safety-valve pending the time during which we were elevating the temperature of the coil to the

melting point of tin, and directly we reached that point the water was discontinued and the grease went in. I mean to say that the whole use of the pump on this pressure of two thousand pounds was limited to about two hours—one and one-half hours to the pumping of water and one-half hour to the pumping of emulsion. Then we removed the pump, took it back to the factory where it was built, and instructed the builder to put in a packing there that would work against two thousand pounds pressure, and not be liable to disintegrating effect from the hot tallow. He made many experiments upon it. He tried a common stuffing-box of the ordinary kind, something that we could screw up from time to time, and we found that when we could get that tight enough to prevent the exudation of water at that pressure the friction was enormous, and we could scarcely drive the pump; it was impossible to work it. Finally, he made some thin copper cups, that were spun of twenty-two, twenty-four, or twenty-six copper and thinned down afterwards with the hope that they might do. These failed also. They would leak under the pressure. We then made some
1291 experiments with a mixture of tallow and water, preserving the proportions as named in the specification, and with a view to determining how, or rather, what was the lowest temperature at which the grease would be fluid, or, perhaps, if we could diminish the heat somewhat, we could retain our cup-leather longer. We discovered there that so long as we maintained the temperature of the mixture at or below 112°, the leather seemed to stand very well, unchanged; but when — went above that, it would shrivel up and get so limber that it would have no consistency. We then resolved to use the cup-leathers, and introduced an additional device, not suggested by the specification or by Mr. Tilghman, for the purpose of maintaining the temperature of the emulsion at or near 110°. That consisted of a box, perhaps forty-two inches or forty-eight inches long, ten inches square inside, through which the suction-pipe to the pump was passed, joints made tight at the ends with lock-nuts and leather washers—simply a wooden box, and open at the top. Into that box we introduced a cold-water pipe and a steam-pipe, by regulating the quantities of cold water and steam introduced, or varying at our pleasure. The assistant who had charge of it was able to maintain the temperature of the emulsion passing into the pump at 110° Fahrenheit, which was the lowest point at which we were sure the grease would be fluid and flow readily through the valve-chambers of the pump. That we found, upon subsequent experiment, was sufficient to control the temperature of the mixture coming into the pump, and we had no further trouble from that cause. This box was surrounding the suction-pipe to the pump. It was the same pipe I described this morning. Between this box and the suction-chamber of the pump we inserted a T, and in the branch of the T we put a screw-joint thermometer, which the assistant read continually; in fact, whenever he discovered the temperature
1292 elevating materially above 110° he would diminish the steam and increase the cold water, and when he found the temperature receding below 110° he would increase the steam and diminish

the water. In that way he was enabled to control that temperature within a range of three or four degrees. After making that change and putting the pump in as good shape as we knew how, and finding nothing but the cup-leather would answer as a packing for the pressures that we were carrying, we restored the arrangement and made another test upon the 3rd of May.

We did nothing to remedy the leak in the apparatus. That must have been a leak at some one of these Perkins joints, that took place after we began to pump the emulsion through the coil. All those were enveloped in this mass of cast iron, and it was impossible to get at them and repair them. It must have been a leak in one of the screw joints in the wrought-iron coil proper, because, if it had not passed through the joints it could not pass through the casting, and of course it is a matter of some uncertainty as to where that joint was located, because the grease would pass around the pipe and finally vent itself through the casting at that point where there was the most metal and the least density, which would be one of the trun-ions, the mass of metal being materially increased at those points. Now, while recognizing that we could do nothing to prevent that leak, there was still a desire on the part of Mr. Gamble to make an experiment and have this emulsion passed through and ascertain what its condition was as it vented from the safety-valve, and on the 3rd of May we made another experiment, which continued until we were driven out of the house by the leaks and smells that were created there. During the 3rd of May we were able to run it an hour and fifty-three minutes whilst passing the grease through it.

1293 By the way, everything seemed to go pretty well until we began to put the fat in and then the trouble ensued. The coil handled water nicely. During the time we were trying it on the 3rd of May, the pressures were read every five minutes; tests of of the temperature of the coil were made simultaneously with the reading of the pressure; the temperature of the product as it came from the safety-valve was taken likewise every five minutes; the mixture was introduced at the rate of twenty-three pounds of fat to ten and one-quarter pounds of water every ten minutes, and the pump was carefully watched and speeded to prevent its kicking up and destroying the experiment, and the temperature of the emulsion was regularly read every five minutes, so that we might have a record of how things were going on down-stairs. We had an assistant who was reading the temperature of the emulsion passing through the pump; another who was noting the speed of the pump and controlling it; still another, who was managing the fire; still another, who was reading the temperature of the coil from the metals that were used, and the pressure from the pressure-guage; still another, who was controlling the delivery of water to the condensing cask; still another, who was noting the temperature of the outflow from the safety-valve; and two, who were measuring the quantity of fat and water to be introduced into the churn, besides the two men who were doing the churning.

When we started into it again, all the joints, so far as we could

reach them—all the exposed joints—were carefully looked to and made tight, and we started in without any leak whatsoever, except the leak through the coil proper—I mean, leaks in any of the exposed joints, where we could possibly get at them. There were three exposed joints—a coupling near the discharge side of the coil, another one about half way between them and the condensing coil,
1294 and still another immediately over the condensing coil. They all leaked more or less. The leaks took place after we had run some time, after the travel of the grease had been fairly established. They would not leak at all as long as we had the water passing through it, and with the same pressure and temperature; but there seemed to be something in the grease itself that contributed to open those joints, or, perhaps, the grease would pass through a smaller opening than the water would. Those joints had all been made as tight as we knew how to make them, and when we went into the trial with the grease they remained tight considerably more than an hour. This was the second trial of the 3rd of May, after putting the pump in shape and making this box for controlling the temperature of the emulsion to the pump. These joints seemed to remain tight for considerably more than an hour. We were congratulating ourselves that we were able to run some time without any drawbacks, and then the middle joint, the second one noted in the testimony, opened first, and then the joint next to the decomposing coil opened. By the way, that was a Perkins joint also, next to the coil, while the other exposed joints were flanged joins with copper gasket. The last joint that broke was the one immediately over the condensing coil, and with that opening the experiment was discontinued. In some manner there was no breakage of the parts at all, no splitting of flanges or tearing of bolts; it seemed to open and we then lost everything. No further product came through the safety-valve and the test was discontinued.

I have here a resumé of that trial, giving the temperature of coil, the pressure that was maintained with that temperature, the temperature of the product as it came from the safety-valve, and the mean temperature of the emulsion as it went to the pump. I have also the total quantity of emulsion delivered to the pump,
1295 the total quantity of product obtained, and the amount of emulsion lost by leakage of coil and joints, the rate at which the product was delivered per hour, and the duration of the trial. This I will put in at this point as part of my testimony. It is as follows:

(It is agreed that the following extract shall go in without objection, counsel for defendants to have the privilege of verifying those observations which the witness has not personal knowledge of.)

"MAY 3RD, 1883.

Result of Trials [of] Tilghman Coil.

Temp. of coil.	Pressure.	Temp. product.	Temp. emulsion.
Under tin	2,062.5	141.6 F.	112.5 F.
Melting point of tin	1 900	139.33 "	115 "
Above tin	1,666.66	138 "	114 "
Melting point of bismuth	1,800	148 "	114 "
Above bismuth	1,925	159.5 "	113 "
Melting point of nitrate of potash	1,841.7	119 "	113 "

Emulsion pumped into coil	377.75 pounds.
Emulsion lost by leakage of coil and joints	99.75 pounds.
Product obtained	278 pounds.
Product per hour	146.3 pounds.
Duration of test, hours	$1\frac{53}{60}$."

I did not take all these measurements myself, but they were all taken under my direction, and I believe they are all correct. The assistants were all instructed by me, and I watched them closely enough to see that they were doing what they were directed to do—that is, I made it my special work to see that they were complying with the directions, and that they were not remiss in making the observations.

1296 By Mr. CHAMBERS:

Q. Were these assistants you speak of employed by you or by Procter & Gamble?

Witness continuing:

A. They were employes of Procter & Gamble about the factory. I had been asked how many were needed, and I gave them the number, and they made a detail, principally men from the office, intelligent men about the concern. Mr. Donnelly, who is one of their old employes, and, perhaps, was at one time superintendent of the factory, made the weights of fat and of water. A Mr. Cooper Procter read the temperature of the product from the safety-valve. Mr. Arthur Procter took the temperatures of injection and overflow to the condensing cask. Mr. Manning controlled the temperature of the emulsion. (Mr. J. H. Manning was in my employ. I took him there purposely to manage the pump, because he was very skillful in that class of work.) Mr. Manning and their engineer, J. H. McCabe, jointly looked after the motion of the pump, and controlled the temperature of the mixture to the pump. They were both together. Mr. Manning was charged with seeing that the pump was just right. Now, there was a boy who was called George, who put the coal into the furnace under my direction. I read the pressure-gauge, regulated the pressure, and took the temperature of the metals in the top of the coils. Prof. Dudley took samples of the

product from the safety-valve, divided the labor with me in reading the temperatures of the metals in the top of the coils. Prof. Dudley is an analytical chemist, located in this city, and I believe his name is W. L. Dudley. He is not an employe of Procter & Gamble. He is the chemist for this Iridium Company—the inventor of
1297 this iridium-plating process—and his office is in the Miami Medical College. All were employes except Mr. Manning, Prof. Dudley, and myself; the balance were men that were detailed from the office and the shop.

This record I have in my hand is my own note-book. It gives the time that ensued from the beginning to the end of the test, the time when the emulsion was started through the pump, and the time when the experiment ceased, and contains my own readings of the pressures pumped against and the temperatures as indicated by the fusion of the metals in the top of the coil. This note-book contains the reading for every five minutes, together with notes that have been jotted down through the trial. With the following explanation, the figures in the resumé are in my note-book: The first pressure given is the mean of the first four pressures given in the note-book, opposite which will be found *as* a note for temperature "under tin;" the next mean pressure is the mean of the next two pressures in my note-book, at a point where tin is melting; the next mean pressure in the resumé is the mean of three pressures in the note-book — "tin entirely melted;" the next pressure is a single pressure opposite the note "bismuth metal;" the next mean pressure is a mean of two pressures in the note-book opposite "bismuth melted," and the last mean pressure in the resumé is a mean of nine pressures in the note-book under the head of "nitrate of potash melted." With that explanation, those pressures are in the note-book. What is true of the mean pressure given in the resumé is equally true of the other elements noted by reference to the times of my note-book and the corresponding times of the other note-books that are used for that purpose. The following is a copy of the entries in my note-book which I have referred to:

1298 (It is agreed that the following extract shall go in without objection—counsel for defendants to have the privilege of verifying those observations which the witness has not personal knowledge of.)

MAY 3RD, 1883.

Procter & Gamble Factory.

Time.	Pressure.	Temperature.
11.27	2,050	Under tin.
11.42	2,000	"
11.50	2,100	"
11.55	2,100	"
12.00	1,800	Tin melting.
12.05	2,000	"
12.10	1,800	Tin melted.
12.15	1,200	"

Time.	Temperature.	Pressure.
12.20	2,000	Tin fluid.
12.25	1,800	Bismuth melting.
12.30	2,000	" melted.
11.35	1,850	" "
12.40	1,950	Nitrate of potash.
12.45	2,150	" "
12.50	1,950	" "
12.55	1,200	" "
1.00	1,900	" "
1.05	2,075	" "
1.10	2,150	" "
1.15	2,100*	" "
1.20	2,000†	" "

I have told about this trial of the 3rd of May as much as I know about it. We wound up after everything leaked so badly that we could go no further—then cut off the grease from the coil and started the water through it.

1299 By Mr. CHAMBERS:

Q. Please explain one thing—toward the bottom of your note-book page, it appears "nitrate of potash;" does that mean that nitrate of potash was melted?

Witness continues: A. The nitrate of potash was so fluid that you could readily twist the stem in it at all times when it is noted in my note-book "nitrate of potash," and at all other times prior to that, of course, the wire could not be moved because it was tight. We made an effort to manage the fires so as to hold the temperature at those different points as well as we could, but it was a very difficult matter. What I wanted to say about maintaining the temperature is, it was hard to control it and hold it where we would like to have it. While this stuff was leaking from the coil it was impossible for men to work in the room. There was some very powerful irritant that would affect the eyes, the membrane of the throat, and cause coughing, sneezing, and weeping; we dragged one man out, who needed a little resuscitation to straighten him out. It was not the smell but the irritating effect that the whole room was charged with that troubled us. The experiment of the 11th of May is also in my note-book—such notes as I took—which were of the same character as those of the 3rd of May, being the times when we began to pump the emulsion into the coil and when we ceased the experiment, and the pressures for every five minutes during that interval, and the temperatures that subsisted during that time, and I have a resumé of that also, which is like the first one. The entries in my note-book are as follows:

(It is agreed that the following extract shall go in without objec-

*Acroleine too strong for the workmen.
†Changed from grease to water to reduce temperature of coil.

tion, counsel for defendants to have the privilege of verify-
1300 ing those observations which the witness has not personal knowledge of.)

"MAY 11TH, 1883.

Procter & Gamble.

Time, p m.	Pressure.	Temperature of coil.
3.13	1,950	Tin melted.
3.26	2,000	"
3.30	2,050	"
3.35	1,850	Bismuth melted.
3.40	1,700	"
3.45	1,800	"
3.50	1,950	"
3.55	2,000	Tin melted.
4.00	1,800	"
4.05	1,850	"
4.10	1,900	Bismuth melted.
4.15	1,925	Lead melting.
4.20	1,950	"
4.25	2,000	"
4.30	1,950	Lead melted.
4.35	1,850	"
4.40	1,400	"
4.45	1,700	"
4.50	1,800	"

Fat worked 368 p'ds.
Water 116 p'ds.
Returned 116 p'ds of mixture."

The entries in the resumé are as follows:

(It is agreed that the following extract shall go in without objection, counsel for defendants to have the privilege of verifying those observations which the witness has not personal knowledge of.)

1301 "MAY 11TH, 1883.

Results of Trial [of] Tilghman Coil.

	Temp. of coil.	Pressure.	Temp. product.	Temp. emulsion.
Melting point of tin		2,000	165 F.	107.5 F.
Melting point of bismuth		1,825	173.75 F.	112.25 F.
Melting point of tin		1883.5	165.3 F.	113 F.
Melting point of bismuth		1,900	189 F.	110 F.
Melting point of lead		1,958.3	158 F.	110 F.
Above lead		1,740	148.4 F.	111.5 F.

Emulsion pumped into coil { Fat, 287.76 / Water, 128.24 } 416.00
Emulsion lost by leakage of coil and joints 225 pounds.
Product obtained 191 "
Product per hour 118.12 "
Duration of test, hours $1\frac{37}{60}$."

This test, as the column of temperatures indicates, was better than the other—that is, more regular and more reliable than the test of the 3rd of May, because we began to pump in the grease at the melting point of tin, and never reached the melting point of nitrate of potash. We may have exceeded the melting point of lead, but we never melted the potash. Now, this resumé gives, relatively, the same results of that trial. This trial was discontinued because all the joints opened on us again. Now, I wanted to say, that we took off the flang joint, the one that gave us the most trouble, in the center of the pipe, and supplied its place with a coupling, with right and left threads, similar to the Perkins joint, although I am not sure that we used the chamfered ends to the pipe at all. The change in the joint was made between the test of the 3rd of May and the test of the 11th of May; but we made a joint, with right and left running threads, in place of the flange, and it remained tight until very nearly the close of the last trial, and then it began to
1302 leak, and the leakage finally was so great that we had nothing coming from the safety-valve, and we stopped again.

In both of these trials the emulsion was delivered to the coil at such a rate as to make our delivery of approximately 138 pounds an hour from the safety-valve, in addition to what we lost through the break in the coil somewhere. That fat which went into the fire is not included in the product delivered, and it was somewhat difficult to maintain a steady flow through the coil.

In the trial of the 3rd of May our delivery was at the rate of 146 pounds an hour, and in the trial of the 11th of May 118 pounds an hour.

We undertook to add to the established rate per hour, which we fixed at 138 pounds, by calculating the leakage. Now, of course, the leakage was an uncertain quantity, and the only way that we could arrive at it was to measure from time to time the flow from the safety-valve; that was through a period of two and one-half minutes, during which time we should have got, approximately, eight and one-half pounds. After we had carefully adjusted the pump to deliver the eight and one-half pounds in two and one-half minutes, without any disturbance of the pressure or of the speed of the pump, that rate of delivery would change, either become less or become more, and, of course, we were constantly drawing off these charges and endeavoring to maintain the rate of flow as near our 138 pounds as we could.

For the 3rd of May the total amount of emulsion pumped in was 377¾ pounds in the whole operation; 278 pounds came out; the difference was lost by leakage in the coils and in the joints. This means the emulsion by water and fat both. Five parts by bulk was water—that is, the water was five-twelfths the bulk of the fat; there was five parts of water and twelve parts of fat; five-seven-
1303 teenths was water and twelve-seventeenths was fat by bulk.

The specification says that the water shall be in the proportion of one-third to one-half by bulk, and we took a mean, which was five-twelfths of the fat by bulk.

While the pressure and the speed of the pump remained constant

we would have a variable delivery; and that obliged us to increase or diminish the speed of the pump very frequently. The fluctuation in the rate of delivery is best shown in the variations in speed of the pump, which was taken by Mr. McCabe. These are not my figures, but he was instructed to change the speed of the pump every time we discovered any variation from the proper delivery; and how often this occurred is shown in the note-book. The pump was an independent steam pump, that we could control and speed as we chose, by varying the supply of steam. A man stood there, and did nothing but manipulate that as he was directed, the intention being to comply with this rate of speed as nearly as we could; and, if we failed to do it, it is because we were not able to do it.

On the trial of May 11th, the total emulsion pumped into the coil was 416 pounds, and the product obtained was 191 pounds. Our leaks increased on us, and the loss by leakage was 225 pounds. I would like to suggest that these breaks in the joints were not gradual. While they might appear some minutes before the final rupture took place, they ultimately seemed to be very sudden, and everything let down at once like a collapse.

There is one statement in the early part of this answer that I would like to correct. It is this: The statement is made that we supplied the fat and the water to the coil, or to the emulsion churn, at the rate of 23 pounds of fat and 10¼ pounds of water for every ten minutes of time. That was so long as there appeared no leak through the coil proper, but as that leak increased, which it seemed to with
1304 each trial—increased towards the end of the trial—then this ten-minute operation was determined at the delivery, and the quantities were delivered to the churn faster, in order to supply whatever that leak might be—that is to say, that 23 pounds of fat and 10¼ pounds of water applied only to the thing in perfect condition, when we were not losing through the leak in the decomposing coil.

Mr. James N. Gamble was present at all the experiments and substantially present all the time, going in and out.

For the experiment of May 11th there were present all the people who were there the test before, except a change was made in this man who had too much of the acroleine; he refused to serve again, and we had a new man for that. They called him Robert. And then Prof. Morton and Dr. Endemann were there, as well as Mr. Dudley.

Q. 6. Who, if anybody, was taking samples of the product during the experiments?

A. For the 3rd of May I stated that Prof. Dudley took samples, and for the 11th of May I would say that Dr. Endemann took samples, and I think Prof. Morton took one or two of the early samples. The young man who took the temperature of the outflow was instructed at the time, the time when the samples were taken and who took them.

By Mr. B. C. TILGHMAN:

Q. 7. Was the Perkins joint between the exit of the heating-coil

and the cooling-coil made by means of a sharp edge on one tubing biting into the flat surface of the other tube?

A. That joint was made while I was not present at the factory. The instruction to Mr. Manning (the piper) was to make such a joint there, and in fact all other places; but all that I can answer
1305 for that is that it is a right and left thread, and if it is not a Perkins joint it only lacks this cutting feature. I am not certain, because this joint was made while I was not present.

There is a peculiarity about the joints here that they would remain tight for a period of time and then leak. This particular joint was screwed up as tight as we could make it, and for an hour there was no evidence of leak, when suddenly it began to spurt.

By Mr. PARKINSON:

Q. 8. Was what you say in your last answer about your having no personal knowledge as to whether the Perkins joint there referred to was chamfered or not, in reference to the joints within the casting, or only to that outside?

A. These joints immediately outside of the trun-ions. There were two of them made in this manner—the inlet joint, which never gave us any trouble, and the outlet joint, where the serious leakage occurred. Those were joints outside of the decomposing coil proper.

Adjourned until to-morrow (May 23rd, 1883), at 10 a. m.

Hearing May 23rd, 1883.

Morning Session.

Continuation of examination of JOHN W. HILL.

By Mr. PARKINSON:

Q. 9. You have spoken of some modifications in the appa-
1306 ratus used, as compared with the Tilghman patent. What was the purpose of those modifications, and what effect would they have upon the successful operation of the apparatus as a whole?

(Objected to, as the witness is not shown to have had sufficient experience in the art to warrant his giving an opinion.)

A. The only variation between the decomposing coil, as we built it and as it is described in the Tilghman specification—that is, the only material deviation, in my opinion—is the thickness of space between the pipes. The Tilghman specification says that they shall be one-quarter of an inch. As already stated in my testimony yesterday, it was believed that we assumed some risk in making the couplings no thicker than a quarter of an inch, and upon the advice of the piper who built the coil they were made five-sixteenths of an inch, or intended to be five-sixteenths of an inch, and are actually nearer three-eighths, perhaps, as I found upon measurement of the coupling that we have here. I understand, from reading the Tilghman specification, that the cast iron is used substantially as a reservoir or regulator of heat. Perhaps I can make my

meaning more clear by saying that having a large mass of cast iron to be heated, likewise to be cooled off, that the fluctuations of the temperature of the coil and of the matter within the coil would be less rapid than if the coil was heated direct. Mr. Tilghman also says that the cast iron which is poured about the wrought-iron coil contributes to its strength, which is true. Now, in my opinion the thickening of this space is certainly no disadvantage to the decomposing coil, either as affecting the capacity of the cast iron to act as a regulator of heat or as affecting its strength, and rather to the contrary. I mean to say, however, that the purpose was not to improve upon the coil as described in the specification at all, but
1307 it was done because we felt it was unsafe as a matter of mechanical construction to follow his directions in that particular, and I believe the change that was made in increasing this thickness was calculated to be a benefit, rather than a detriment, to the strength and operation of the coil.

Q. 10. Do you understand a quarter of an inch in the Tilghman patent to be mentioned as a maximum or minimum limitation upon the space that should be allowed between the coils?

A. I understand the quarter of an inch mentioned in the Tilghman patent to be a mean dimension of the thickness of metal or of the space between adjacent pipes. In support of which I shall quote the language of the patent as follows (I read from page 9 of the record): "The different coils of the tube are kept about a quarter of an inch apart from each other, and the interval between them is filled up solid with cast iron." I would understand "about" to allow some reasonable variation in that thickness, and I should not consider the increase of the thickness to $\frac{3}{8}$ths of an inch as objectionable in the light of this language.

Q. 11. Does the section of pipe introduced here as an exhibit show the finish of the pipes used in this apparatus? If not, in what respect does it vary?

A. The section of pipe—this particular piece—was rejected when the coils were examined before bending, and after the threads had been cut and the ends faced and chamfered, respectively, by reason of the tearing of the thread, as the exhibit shows. So far as the simple facing of the end of the pipe is concerned, this is a fair sample of the work done, but the feather-edge that is shown around the periphery, as also the feather-edge that is shown projecting inward and diminishing the bore, were carefully removed with a fine file before the pipes were used to make the joints. That piece—this exhibit—
is not a complete end of the pipe, because it was rejected and
1308 thrown aside, and does not exhibit the finish as perfectly as the joint itself would, for the reasons noted.

Q. 12. What, if any, precautions did you observe in the construction and operation of this apparatus to secure the best attainable results?

A. Originally, the pipe was ordered, instructing the agent who furnished it to insist upon the best quality double extra strong hydraulic pipe. Before the invoice of pipe was accepted, each particular piece was tested by forcing water under pressure from the city mains

through it to prove that it was clear and free from obstructions, other than such obstruction as are necessarily found in all such pipe, due to the manufacture of it, or, in other words, this wrought-iron pipe is never made equal to a bored hole, and cannot be; omitting the natural obstructions due to the weld of the pipe, it was perfect. Of the lot that was ordered, one piece was found to be so clogged as to prevent the free delivery of water, and was rejected. The pipe was then sized for length for each of the three series of coils, then faced with what is known in machine-shop parlance as a sweep or pin-drill, for the flat-surface end, and with a similar tube a sweep or pin-drill for the acute surface of the opposite end of each piece of pipe that entered into the construction of the coils. Before the different pieces were bent to proper dimensions, I examined the ends to determine whether they were satisfactory and whether they would make, in my judgment, a perfect joint as I understood Mr. Tilghman's description of his joint in his patent, and where there was a question about it, the ends were either re-turned, or re-tooled, or rejected, as the case might be, this particular specimen of the pipe being one of the ends that was cut off as not being satisfactory, as several were cut off on account of the threads not being satisfactory, and sometimes the ends were not perfect. Whenever there was a doubt in my mind as to its making a perfect job, the
1309 piece was rejected. The couplings that were employed were forged solid, drilled in a chuck and then threaded partly by a threading-tool in a lathe, and finally by a sizing-tap, the intention being to have all portions of the coil as near perfect as my knowledge and the skill of the pipe-fitter who made it could accomplish.

Q. 13. Please state what, if any, practical difficulties were encountered in the construction and operation of this apparatus which would affect the extent of its utility for manufacturing purposes, and how far, if at all, such difficulties could be removed for practical purposes by any means within the knowledge of those skilled in the art, so far as you know.

A. There are several mechanical difficulties that I can conceive are necessarily concomitants of such a machine as is described in the Tilghman specification. The first that presented itself to me, upon investigation, was the certainty, in my opinion, of the breakage of this decomposing coil very shortly after it went into use; in other words, I cannot conceive how a wrought-iron coil, considering its rate of expansion for a given increase of temperature, can be enveloped in a mass of cast iron; also, considering the rate of expansion of the cast iron for a given increase of temperature, with safety either to the joints of the coil or to the casting, on account of the smaller rate of expansion of cast iron as compared with wrought iron; the rate of expansion of wrought iron is materially greater than that of cast iron, for any given addition of heat or temperature. In this particular case a wrought-iron coil is described as being enveloped in a cast-iron shell. I cannot conceive how it is possible to heat that coil even to the temperature elected in the specification, without serious risk either to the joints by the strain due retarded expansion, in the event a break did not occur in the

cast iron, or without risk to the cast iron itself; in other words,
I conceive that one of the two things must happen,
1310 either we will strain the joints sufficiently to permit of their
leaking or passing the emulsion through them into the cast iron, or we will break the casting itself. Now, my reasons for this conviction are as follows: My first inquiry into the merits of the decomposing coil proper was after Procter & Gamble had made one of these decomposing coils; they had it set up in their establishment and had broken it prior to experimenting with it with grease. I was requested to examine the coil and, if possible, give a reason for the breakage. I did examine it; had the brick-work torn away and finally had the coil removed for the purpose of a careful examination, and believed then, and still believe, that the cast iron broke by reason of the extra expansion of the wrought-iron coil within the cast iron. The first coil that was in there, which had been made before I became connected with the experiment, was broken across the bottom in a cruciform shape, one crack running up perhaps 18 inches on one side and 12 or 13 inches on the other side, the crack being wide enough to thrust a penknife-blade nearly a $\frac{1}{16}$th of an inch thick into it at the wider places; there was another crack running nearly at right angles to that and the two crossed in the form of a cross, and the second crack that I mentioned extended nearly or quite around the entire coil—the entire bottom of the coil; these cracks were all located at the bottom, at the lower semicircle; and, when I say entirely around it or nearly so, I mean around the section and not around the coil in the direction of its length. Directly that crack occurred it was stated and afterward proven by experiment when I went there that it leaked water. How it was made or whether it was a coil complying with this specification or not, that I don't know; but, at all events, it did leak badly and the water would pass through these cracks at the bottom of the casting. I
said that I believed then, and still believe, that coil broke by
1311 reason of the of the extra expansion of the wrought-iron coil over the expansion of the cast-iron shell that enveloped it. In order to satisfy myself that I was either right or wrong, as the case might be, I constructed another coil, a small one, with the consent of Procter & Gamble, which was made of solid pipe where there were not any joints to be strained, and where the probability is that if there was any objection to the different rates of expansion it would manifest itself in the breaking of the cast-iron shell about the pipe. This small coil was made of 1¼-inch pipe and contained two coils representing about six feet. The amount of cast iron about it was possibly greater than what the specification would call for, and to that extent I conceive possibly stronger than the specification elects. That coil was tested by passing water through it, carefully heating it up in an open furnace with charcoal to a temperature of melting lead—that temperature being determined by a cell that was provided in the upper side of the coil as it lay in the fire—the purpose being to determine whether the breakage would occur or could occur whilst maintaining a temperature of melting lead in the coil and under a pressure as great as we were able to attain with

the pump at hand, which was 1,000 pounds. After we had operated it about an hour a snap occurred, and upon removing the fire we found the cast iron of the coil was cracked entirely through; that crack took place at the end of the semicircle, or rather where, if you can conceive it, the semicircle joins the tangent, or where one of straight sides of the coil joins the curved end, and the separation was about $\frac{3}{32}$nds of an inch. I now produce the small Tilghman coil referred to in the previous portion of this answer.

(The coil referred to is here offered in evidence and marked "Defendant's Exhibit Small Coil.")

1312 After the experiment had been made with this small coil and suggesting to Mr. Gamble the belief that it would be impossible to make such a coil as Mr. Tilghman describes that would be practicable—that would not be liable to either the straining and leaking of the joints of the wrought-iron portion, or of the breaking of the cast-iron portion, he then decided, notwithstanding the possibility of accident, to build the large coil which was described in the testimony of yesterday. In the construction of the large coil, bearing upon this same question of injury to it in use, I can conceive of no greater care being exercised than what Mr. Manning and myself gave it, in order to make the joints, or, rather, the sections of pipe, when jointed, equivalent to a solid pipe from end to end; in fact, at one time we seriously considered the propriety of having five hundred feet of one-half inch pipe, but, upon inquiry, we found the mills were unable or unwilling to make it, in order to make a coil solid from end to end and to have no joints in it. We found, with the facilities of the pipe mills of the present time, that either they could not or would not fill such an order. Moreover, it involved the necessity of making the wrought-iron coil at the place where the pipe itself was made, because a length of pipe of five hundred feet could not be shipped very conveniently. I merely mention this circumstance to show the strong desire that I had at least to make that equivalent to a solid pipe, believing that whenever we did so we were bound to break either the wrought-iron coil or break the cast-iron shell. Now, our experience with this large coil, I believe, sustains my conviction that the apparatus is impracticable, mechanically speaking. It had been very carefully fired up after the setting was completed and all the connections made, water being put through it, and the temperature and pressure gradually raised during a period of twenty-four hours, with a view of avoiding
1313 any sudden changes of temperature and pressure that might influence it—be capable of breaking or injuring it—and directly we began to put the grease into the apparatus, or during the thirty minutes' experiment noted in my testimony of yesterday, something did occur in that coil sufficient to strain some of the joints of the wrought-iron portion and render it leaky and unfit for practical use, in view of the large loss of fat—in round numbers, one-third of which escaped into the fire.

Now, the next objection that seems to me to be a necessary feature of this apparatus is the extreme difficulty of supplying it at a regular

speed with such an apparatus as is described in the Tilghman patent. That is said to be a pump. It is shown in the drawing as a plunger pump, of the ordinary single-acting kind, I infer. Such a pump was used of as perfect construction as we were able to procure, even with our facilities of to-day. Moreover, to insure a uniformity of delivery, an engineer was stationed at the pump to run it. As already noted in my testimony, even when the pump seemed to be operating at uniform speed, and, so far as we were able to ascertain, the suction and delivery valves were working properly, and the pressure maintained practically constant, even then there were variations in the delivery of matter through the coil—the pressure on the coil against which the pump worked, the pressure indicated by the safety-valve—at all times being greater than that due the vapor of water, due the temperature which we were carrying on the coil. The intention was always to have that several hundred pounds above the pressure due the temperature of water for any temperature at which the coil was working or was worked. I mean to say, if we were carrying a temperature of 440° Fahrenheit, which would be the melting point of tin, that we had a pressure of 1,000 pounds; if we were running at a temperature of the
1314 melting point of lead, taken at 612°, the pressure was maintained at from 2,000 to 2,200 pounds. Notwithstanding these precautions, we were unable to have an apparently uniform delivery of the matter through the coil. The class of pump necessarily used to pump against the pressures necessary in the operation of an apparatus as described in the specification is necessarily different from the ordinary pumps for supplying steam-boilers and for pumping against an ordinary head. It is a special pump—a hydraulic pump, it is termed in the arts. I am not aware that a successful packing for the plunger of a hydraulic pump, other than the cup-leathers in general use, has ever been devised; nor do I conceive, from such experience as I have had with pumps working against high pressures, of a better or more reliable packing than the ordinary cup-leather. So far as I am aware, I believe it is in general use all over the world for this purpose. Now, the cup-leather, assuming it is a necessary feature of such a pump, is very capable of doing the work, and was worked through days, weeks, and perhaps months of time against a pressure of 2,000 pounds, and very successfully with water. I believe when we begin to pump the emulsion of fat and water that there is a demoralizing effect in this grease that deteriorates the cup-leather very rapidly. That has been our experience, at least. I think it is possible, if the temperature of the emulsion passing to the pump is kept low, but a few degrees above the point at which we are certain the grease will be fluid, a cup-leather might bear for some hours, perhaps for some days; but even then I think the grease has some action upon leather. It seems to be so in other pieces of machinery; when grease comes in contact with leather it seems to unfit it for a packing joint. In the use of cup-leather for a plunger-pump some difficulty is experienced and a considerable time is requisite
1315 to renew such a packing. In an ordinary stuffing-box packed with either metal, hemp, or cotton it is not a difficult matter

to take out all the packing and introduce new, but with a cup-leather it is necessary that the plunger be withdrawn entirely from the chamber of the pump sufficiently to drop the cup-leather into the stuffing-box and then to pass the gland in on its screw-threads, then finally to restore the plunger. Our experience with this particular apparatus was that it was a difficult job to renew that in much less than an hour with the pump that we had. If I understand the Tilghman specification aright, and if I understand Mr. Tilghman's testimony, being at the page noted in my evidence yesterday in the record, a uniform delivery of this matter to the coil is essential to its success. I think I am quite sure in saying that that is a part of his testimony and is a part of the specification. We certainly could not, with the materials or the facilities that we had at hand—and I know they were very much better than the materials which were at hand when Mr. Tilghman developed this thing—we were unable to produce that condition; nor is it clear to my mind, even with the best facilities of to-day, how you could supply that decomposing coil with the emulsion in such a manner as to insure a practically uniform rate of delivery. That, I conceive, is a serious objection to the operation of it as that operation is described in the Tilghman specification and in his testimony. Again, our safety-valve was of a pattern that is in general use for hydraulic purposes to-day, and was an ordinary lever-valve, with what purported to be a chilled seat and a steam metal plug, and that was carefully reground each time we went into the experiment. Each time that we terminated the experiment the valve was leaking considerably. I conceive that, to comply with this condition of a uniform rate of delivery and a reasonably uniform pressure for the different temperatures employed, *that* the safety-valve should not be liable to easy corrosion and that it should remain
1316 practically tight during the use of the machine, subject to the ventage of such stuff as is properly propelled through it by the pump at the pressure carried. I mean to say that if the safety-valve was loaded to 2,000 pounds and the load expressed by the action of the pump was less than 2,000 pounds, there should be no ventage of material; that at all pressures under the load to which the safety-valve was adjusted the safety-valve should be tight. If it is not tight I cannot conceive how we can have this uniform rate of delivery from it, which I understand is one of the conditions of the process or the operation of this apparatus.

The spring-balance used in this particular case was entirely new; had never been used before. It was always adjusted during the time of an experiment with my own hands, and I believe was very carefully treated. I believe it was as sensitive as a spring-balance could be whilst expressing the loads represented by the resistance of the safety-valve.

Those are the material objections that have occurred to me, except I will add the difficulty that I experienced in controlling our temperature. Temperature is a material element in the operation of the device, and the temperatures to be employed are carefully noted in the specification. The apparatus was set as nearly like the drawing as we could—assuming that the drawing represented the

apparatus—fine coal was fired, a skillful fireman was employed, and the manipulation of the damper I attended to myself—that is, directed the fireman how it should be set at different stages of the experiment. I found that it was impossible with a coal fire or with the apparatus that we had to control it at any given temperature for any length of time. Directly that would reach the melting point of tin the ash-pit door would be closed and the fire door would cautiously opened, a little careful banking of the fire done. Even then
1317 there seemed to be a sufficient heat accumulated in the cast iron of the coil or in the walls of the furnace to augment the temperature right on up to the maximum point. I do not believe the apparatus as Mr. Tilghman describes it, and as he shows it in his drawings, can be operated with the class of fuel that he evidently had in view when the drawing was made to maintain the temperature he elects, and that to my mind is a fatal objection.

I believe I have noted the four principal points that occur to me. Of course I have already testified upon the difficulty of maintaining our joints tight. Joints that seemed to be absolutely tight under 2,800 pounds pressure with water and with the coil heated to the melting point of tin or bismuth or lead, as the case might be, would leak with the grease. Directly we cut off the grease from the coil and began pumping water through it, those same joints would be tight, and the experience certainly shows that a joint which may be tight under a pressure of 2,000 pounds with water will be leaky under the same pressure with grease. I am quite particular in saying that these joints which were carefully made to develop those facts were tight with water and leaked with grease and were tight with water when the grease was cut off. This is even true of the joints of the wrought-iron coil proper, because careful observation failed to detect at any time a leakage of water through which grease would vent in the cast iron of the coil during our experiments. After the coil was ruptured on the 24th of March, wrought-iron tubes were introduced through the wall of the furnace immediately opposite the points where the ventage of grease took place through which we could see the grease passing when it was venting, and through which I am satisfied we could hear the rush of steam were the coil venting water.

Q. 14. Did you find ony temperature at which the emulsion could be fed at which the difficulty about the destruction of the leather packing was obviated?

1318 A. I have stated in my testimony yesterday a special experiment was made to determine at what temperature the grease was certain to be fluid and in such a condition as to be capable of manipulation by the pump, and found that at or about 110° Fahrenheit the leather seemed to maintain its integrity fairly through some hours of time—I remember now, through about four hours of time. We also found that during this period of four hours the leather seemed to preserve its condition, fitting it for a backing reasonably well, but after that it would soften and lose its stiffness, and finally become such that you could dismember it readily, and

at a temperature materially above 110° the leather would soften very readily.

Q. 15. What would be the maximum duration of the leather in a condition for effective work under the most favorable temperature?

A. From the experiment that I made after the test of the coil on the 24th of March, I am of the opinion that it would be difficult to maintain a leather in successful operation against a pressure to be carried, working the grease at a temperature of 110°, or as near it as you could maintain it as it entered the pump, for more than four or five hours. In support of this opinion I have reason to believe that the new cup-leather, which was introduced upon the morning of the 3rd of May, just before going into the experiment, and which was used in contact with grease considerably less than four hours—about three hours and a half, I believe, in the two experiments—is about ready to be renewed at the present time. I believe this from the manner in which we were obliged to screw down the glands repeatedly during the last few minutes of the experiment, showing that the leather was softening and weakening and losing its consistency.

1319 Q. 16. How would the difficulties which you have enumerated as encountered in the construction and operation of this apparatus affect the utility of carrying on the process by means of it for the purposes of manufacturing on a business scale?

A. Considering the apparatus simply in a mechanical way, I believe that the several objections which I have noted are sufficient to defeat it for practical uses.

Q. 17. Is there any other apparatus, or any modification in this apparatus, or any part thereof, which would, in your opinion, enable approximately the degree of heat and pressure mentioned in the Tilghman patent to be applied in the treatment of the fat, which would obviate the difficulties encountered with this apparatus, and enable the process to be carried on, on a business scale, with more favorable results?

A. I am not sure but what the general description of the apparatus as given in the Tilghman specification is about as favorable, in a mechanical sense, as any I have so far conceived. It is necessary, in devising a coil to work against pressures of two thousand pounds, and to be tested, as suggested in the Tilghman patent, to ten thousand pounds per square inch, to employ extra strong pipe of small bore. Granting that the pipe, or the dimensions of pipe, named in the specification are substantially what should be used to meet the condition of pressure, I can conceive of no better arrangement of such a mass of pipe than in the shape of a continuous coil containing several sections of constantly-diminishing or of constantly-increasing length, and provided with suitable inlets and outlets for the introduction of the material to be acted upon. To meet the case of pressure alone I can conceive of no other apparatus that would do better than that described by Mr. Tilghman, nor of no apparatus that would do it as well. It is necessary, in heating this coil, if I understand the specification aright, that it

1320 shall be heated cautiously and temperature of the matter

within it shall not exceed a given limit, which is placed, as I understand, at the melting point of nitrate of potash. It is also necessary that the coil shall be heated through a medium which shall act as a regulator, or, as the language of the specification states it, that will "insure a considerable uniformity of temperature in the different parts of the coil." I do not know that any substitute for the cast-iron shell around and about the wrought-iron coil could be proposed which would meet this condition and, at the same time, meet the other condition of providing increased strength to the apparatus better than cast iron used in substantially the manner set forth in the specification. It is true that this coil might be heated in a bath of lead or tin or bismuth or sand, or of some of the liquids of high boiling points, perhaps mercury, if there was no amalgamating effect, which would destroy the material of which the coil was made; but none of these schemes would meet the condition of furnishing increased strength to the coil; besides, I conceive they would be very much more expensive than cast iron, subject, in some cases, to a constant renewal of the material employed to form the bath, and, in my judgment, not so mechanical nor so practicable an arrangement as that of the simple cast-iron shell.

Q. 18. My last question was not limited to the effect of any modifications in this coil apparatus which still preserve the mechanical features of the apparatus as described in the patent. I wish to know whether or not there is, so far as you know, any other apparatus, or any modification in this apparatus, or any part thereof, which would, in your opinion, enable approximately the degree of heat and pressure mentioned in the Tilghman patent to be applied in the treatment of the fat, which would obviate the difficulties encoun-
1321 tered with this apparatus and enable the process to be carried on, on a business scale, with more favorable results?

A. I know of none.

Q. 19. How are the practical difficulties and attendant expenses of carrying on a process requiring the application of heat and pressure affected by an increase of the degree of heat and pressure, especially after substantially passing the degree of heat at which steam is obtained?

A. From my personal experience the expense of apparatus and the cost of labor and the cost of repair is relatively much greater than the difference in temperatures and pressures. It is true of hydraulic machinery, where the pressure alone is considered, where only normal temperatures are used, that it is invariably difficult and expensive to maintain, and is never used when anything else will answer the purpose as well. I mean to say by that that hydraulic devices for producing given results are not resorted to as a matter of choice, but, as a rule, as a matter of necessity, the difficulty of maintaining such machinery in condition for practical use and operation being the material drawback.

Q. 20. Just in that connection, as you have spoken of normal temperature, state how it is affected where a high degree of heat is used in connection with a high degree of pressure.

A. It seems to me clear that if it is difficult to operate hydraulic

machinery working against high pressures at normal temperature that the difficulty is increased when you introduce the element of heat due to the expansion and contraction of joints and members of such machinery, thereby producing special strain, which is to be considered and met in addition to the simple strain due that of pressure alone.

Q. 21. Would the difficulties and expense of carrying on a process using water at, say, 600 degrees Fahrenheit, and the pressure requisite to keep it in liquid state at that temperature, be more or less than twice what it would where the temperature is 400 degrees and pressure correspondingly reduced?

1322

A. The pressure corresponding to a temperature of 400 degrees—as I surmise from the data before me in my note-book, where I have computed the pressure for certain exact temperatures—would be about 350 pounds, in round numbers. The pressure corresponding to a temperature of 600° Fahrenheit, in the same manner, would be approximately 1,580 pounds. The cost of machinery to meet those two conditions would be, so far as the weight of material is concerned, about as the pressures, the loads to to be carried being the measure of the strength of parts, and I would rather suspect that the cost would be greater than twice the cost of machinery to meet the pressure of the lower temperature named in the question. I have made no computations for machinery for different purposes. While the cost would not vary exactly in the ratio of the pressures, certain parts would, and as the ratio of pressures is, in round numbers, about as four to one, the strength and cost of certain parts would be practically in that proportion. It is true it would not cost four times as much to construct a cylinder to meet 1,600 pounds pressure as it would to meet 400; but I rather think it would cost more than twice as much.

Q. 22. How about the difficulties of keeping up the higher degrees of temperature in working the apparatus and the precautions that have to be observed where the high degrees of pressure are present?

A. I presume the question means *of* maintaining the high pressure reasonably uniform throughout a period of time. I have found, as a matter of fact, in our experiments that we could not do it with the most careful manipulation of fire and damper, and I understand it to be a necessary condition that the temperature should not exceed the melting point of nitrate of potash in the operation of this apparatus. I made every possible effort to comply with that condition, but we were unable to carry the temperature within any reasonable range, and I doubt whether it can be done with such a furnace and the fuel as Mr. Tilghman had in view when his drawing was made.

1323

Q. 23. How would it be with any furnace or fuel used in the class of manufacture in which this was used, or on the scale of manufacture common in manufacturing establishments?

A. Assuming first that the question would exclude the use of a gas-jet or a multitude of gas-jets and the use of gas as a fuel to warm the coil, and confining myself to the fluids usually employed in manufacturing operations for the purpose of heating, I do not believe it is

possible to maintain those temperatures for any reasonable length of time at the points elected by Mr. Tilghman. Assuming that it would be best to use a multitude of gas-jets for the purpose of heat, which would be very much more expensive than the fuel in general use on a larger scale for manufacturing purposes, but omitting the question of the cost, even then there would be a variation in the temperature of the contents of the coil corresponding with the variations of temperature of the emulsion as it was introduced.

Q. 24. Whenever heating up the coil, either in your first or any other experiments, did you observe the precaution of keeping water in it while heating up?

A. The coil was first charged with water prior to using the fire and the safety-valve loaded to represent a pressure approximately of a thousand pounds. We were not particular as to the exact pressure then, except it was sufficient to prevent the venting of the water from the coil with the temperatures we employed, and that water was kept circulating through the coil while it was warmed up.

There was no time at which the coil was empty. I mean to
1324 say there was no time at which the coil was emptied—I mean to say there was no time at which there was neither water nor emulsion in it while it was heated, the circulation of the water being established by starting a pump prior to heating at all, and then the heating, being gradual through a period of at least twenty-four hours in either instance, care being taken that up to the time of our starting the emulsion through it, that it would never meet the melting point of tin.

Q. 25. What, if any, precaution did you take to obtain a reliable gauge?

A. We bought a pressure-gauge; we first borrowed a pressure-gauge for the purpose of testing the coil before the casting was made, which was a Schaeffer & Budenberg, graduated to ten thousand pounds, and which we loaded to 9,000 pounds, as already stated in evidence. We then purchased a pressure-gauge of the Schaeffer & Budenberg concern under an order to furnish us the best gauge which they had in stock in New York; the gauges are made in Germany. I believe the Schaeffer & Budenberg gauge is recognized as the best in the market. I have had occasion to purchase quite a number for use in connection with hydraulic machinery, and have used several different makes of gauges, those of the American Steam Gauge Company, and of Asheroft, of Boston, and the Utica Steam Gauge Company, of Utica, New York, and in my experience, through several years of time, I believe the Schaeffer & Budenberg gauge is superior to all others. Their gauge we bought and used in taking our pressures.

Q. 26. You have spoken of the men employed in working this coil apparatus. Please state how many would be necessary where it was being operated for business purposes as distinguished from mere experimental tests, and whether those employed would need to be more than ordinary laborers?

1325 A. I am of the opinion that it would be difficult to operate this apparatus with less than six or seven men, and several

of those would have to be of more than ordinary intelligence to maintain steadily the stipulated conditions under which it shall work.

Q. 27. State the purposes for which it would be necessary to have each of the number you have mentioned, and how many of them would need to be specially skilled.

A. It would require a reasonably intelligent man to do the firing and control the temperatures—I would certainly say he would have to possess more intelligence and more skill than I had, for I failed to do it; it would require another man, who should be at least a good operative engineer, to control the temperature of the emulsion passing through the pump and control the speed of the pump delivering the material to the digester coil; it requires a man of reasonable intelligence to weigh off the quantities of fat and water in the proper proportions, and to charge them at the proper times; it also requires a reasonably intelligent man to observe the pressures against which the emulsion is being pumped through the decomposing-coil, and also the temperature of the product as it makes its exit from the safety-valve. In addition to these, at least one laborer would be required to work under somebody's directions and regulate the flow of water to the condensing-tank and control the churn; I am assuming that that churn may be operated by power. Now, I think I have enumerated five men there; then I think that it requires a man of considerable skill and extraordinary patience to stay there and manage the whole thing, because none of these assistants would be in a condition to travel from point to point without material neglect of their duties.

(Mr. Parkinson here states that the apparatus which has been referred to is still in position in the Procter & Gamble factory
1326 in this city, and is open at any time to the inspection of the complainant or of the master for any tests they may care to make with it.)

Direct examination closed.

Complainant's counsel states that neither himself nor the complainant were in any way notified as to the construction of the apparatus referred to or of the tests which it appears have been made of and with it; that it is obviously impossible for them to acquaint themselves with the construction and actual condition of the apparatus, and further, that from the witness's testimony it appears very clearly that the apparatus was broken down and is not now, if it ever has been, in a condition to permit of any satisfactory experiment with it. Counsel also states that the whole matter is immaterial and irrelevant to this accounting, and further, he states that the testimony, so far as it has yet been developed, is contradictory and inconsistent with the facts and testimony already introduced into the record in behalf of the defendants. For the above reasons, counsel declines to take advantage of the above offer.

Counsel for defendants objects to the foregoing narration and criticism appearing upon the record, because, so far as purporting to

recite facts not appearing in the record by proper testimony, it is incompetent evidence, and because, so far as it criticizes or comments upon what is found upon the record, it is incompetent and improper, and moves to strike the same out.

Without pausing upon the validity of either reason given by the solicitor for complainant for declining the offer, the master
1327 rules that he cannot exclude from the record either of the reasons given by him.

Cross-examination waived.

(Signed), JOHN W. HILL.

Recess until 3 p. m.

Hearing, May 23rd, 1883.

Afternoon Session.

JOHN H. MANNING was called on behalf of defendants, and being duly sworn, testified as follows:

Examined by Mr. PARKINSON:

Q. 1. State your name, age, residence, and occupation.

A. My name is John H. Manning; my age about 38; occupation, steam-fitter, 173 Race street; my residence is 23 Laurel street, this city.

Q. 2. What experience have you had as a steam-fitter?

A. I have been working at it in this city for eleven years, for Miles Greenwood, and in business for myself, and probably four years before I came to this city, in Boston United States navy yard, and with Walmouth Co.; it is now Walworth Manufacturing Company.

Q. 3. How long have you been in that business for yourself?

A. About nine years.

Q. 4. What is the standing of this Miles Greenwood Company?

A. They used to be considered as doing the best work
1328 that was done in Cincinnati some time ago, but they began to run down and gradually worked out of the business. That was one reason why I went for myself. The shop ran down, and I had nothing to do.

Q. 5. They have lately done work in other lines of business?

A. They do nothing now but casting.

Q. 6. Have you had anything to do with the construction of a coil apparatus for Procter & Gamble during the last year? If so, state how many.

A. I made two; one I made on the order of Mr. Gamble—rather worked it out myself about the sizes, etc. The second one I made under the direction of Mr. Hill, a little bit different. The first one I made of one-inch double extra strong pipe, and what was called about the best right and left coupling that we could make, heavy wrought iron; and to the best of my recollection there was about 424 feet in the coil, and we put that up and it cracked. Then Mr.

Gamble thought perhaps he had better have some help and asked me if he had not better call in Mr. Hill and see whether I was to blame or not for the breaking. They brought Mr. Hill in, and the next I heard of it was that we were to go on and make another coil, and make it of three-fourths double extra strong pipe, and put in 500 feet, for which he furnished me a drawing. I think this is it. I made it about as near that drawing as I could get it. That is the drawing that I made of the coil. (The drawing referred to is the one marked Exhibit Procter & Gamble, Tilghman Coil, Number 3.)

Q. Was this first coil enveloped in a casting?

A. Yes, sir.

Q. 8. Of what material?

A. Cast iron.

Q. 9. How far apart were the coils?

A. The pipes were an inch apart every way; there was an inch space between the pipes.

1329 Q. 10. What, if any, care did you observe to make a good job?

A. In bending the pipe I was very careful to keep it at a low heat, and the coupling we had made of extra heavy wrought iron—and it was a perfect fit—screwed up as tight as it was possible to do and made tight—made absolutely tight. There was not a particle of leak in it; brought it to the factory and had the metal run out; took it to Procter & Gamble's, put it in the furnace, [and] tested it again with cold-water pressure before we fired it up. Seeing the joints were all tight we went on—fired it up.

Q. 11. How high pressure did you put on before you fired it up at all?

A. I think it was about 2,500 pounds—a little over that.

Q. 12. When you fired it up did you have water in the coil?

A. Yes; we had water before we started the fire.

Q. 13. What became of this?

A. Well, it was taken down, and, I believe, carried across the street somewhere to a vacant lot. I saw it there Sunday—going by.

Q. 14. What led to its being taken down?

A. It was cracked after we fired it up. The day we were going to test it it cracked, just about the time we got it up to the proper heat, and a little while after it commenced to leak pretty bad; so bad that I do not think we could keep the pressure more than 1,000 pounds on it after that.

Q. 15. Did you examine it to see how much it was cracked?

A. Yes, sir; went into the furnace two or three days afterward and examined the crack.

Q. 16. Describe the crack.

A. The crack was—I describe it by drawing lines on the exhibit just referred to, marking on them the word "crack." It may

1330 not be absolutely perfect as to the exact spot, but it was considerably over from the center.

Q. 17. What quality of pipe did you use through this coil?

A. I got the double extra strong from Morris Tasker, made on pur-

pose for the work. I wrote them and told them about what kind of coil I was to make, and asked them to furnish the pipe in as long lengths as possible, so as to have as few joints in the coil as possible.

Q. 18. How would it compare in quality with the best pipe to be had?

A. We always consider that Morris Tasker's pipes are the best, and on getting the pipes we found it a good quality of pipe; did not lose any of it by splitting or peeling off.

Q. 19. What would you say as to the character of the job done in making this coil?

A. The first coil was about as good a job as I was capable of making.

Q. 20. Now, as to the next coil which you made.

A. I considered it an absolutely perfect piece of work.

Q. 21. Did you make any special effort to make a first-class job?

A. Yes, sir, and took more than ordinary care with it. I took probably 33 per cent. more time than we would under any other circumstances, from the fact that we knew it would be subjected to a pretty big pressure, and subject to the inspection of Mr. Hill, and also had to be similar to the drawing.

Q. 22. What was done with that?

A. That we took to the foundery and had it cast, and it was brought up to Procter & Gamble's factory and put in the furnace.

Q. 23. Were you present when it was used there?

A. Yes, sir; I believe I was present every day except two.

1331 Q. 24. What did you have to do, if anything, in connection with the testing of it there?

A. The two last days I was there in running the tallow through. I ran the steam pump and took the temperature of the material going in—the speed of the pump. I cannot recollect the date. (Referring to a memorandum book.) It was May the 3rd.

Q. 25. Was May 3rd——

A. May 3rd was one of the days. The other days I cannot remember; four or five days afterward, I think.

Q. 26. Under whose supervision was the work of May 3rd done there?

A. Mr. Hill seemed to be the man in charge. I kept the temperature as near as we could to what he required—to the speed of the pump.

Q. 27. The last day you were present when this was run who were there?

A. Mr. Hill gave me the orders I had. There were several gentlemen there, but I hardly know what their business was.

Q. 28. Did you, on these two days referred to—that is, May the 3rd and the date which you say was a few days after—make at the time any memorandum of the temperature of the emulsion and the rate of speed of the pump; if so, have you that memorandum?

A. Yes, sir; that is the book I kept it in. Those are my figures. The book has got wet. That is the memorandum I made.

Q. 29. Please, then, refreshing your memory by reference to that

memorandum, give the data, first for May 3rd and next for the subsequent date.

A. It is as follows (reading):

"May 3rd, 1883.—Speed of engine 115, start:

	11.27	110	degrees.	10 m.	80
	11.37	112	"	10 "	80
1332	11.47	113	"	10 "	75
	12.7	115	"	10 "	65
	12.17	114	"	10 "	60
	12.27	114	"	10 "	60
	12.32	112	"	5 "	45
	12.37	114	"	5 "	45
	12.42	112	"	5 "	45
	12.47	110	"	5 "	48
	12.52	110	"	5 "	42
	12.57	118	"	5 "	32
	1.2	118	"	5 "	36
	1.7	112	"	5 "	36
	1.12	112	"	5 "	36
	1.17	112	"	5 "	36"

On the fifth and sixth pages of book:

Time.	Temp.	Pump speed.
3.13	100	" 80
3.18	110	" 80
3.23	110	" 75
3.28	110	" 85
3.33	110	" 80
3.38	112	" 85
3.43	112	" 83
3.48	115	" 80
3.53	112	" 80
3.58	115	" 72
4.03	112	" 72
4.08	110	" 76
4.13	110	" 62
4.18	110	" 60
4.23	110	" 55
4.28	110	" 55
4.33	112	" 55
4.38	112	" 48
4.43	112	" 50
4.48	112	"

1333 The first column is the time, the next is the temperature, the next speed of the pump.

Q. 30. What was the quality of the pump used in feeding the emulsion?

A. It was a McGowan pump, $\frac{3}{4}$-inch piston and 7-inch steam cylinder. I suppose it was about as good a pump as could be got.

(Direct examination closed. Cross-examination waived.)

(Signed) J. H. MANNING.

WILLIAM A. PROCTER was next called on behalf of defendants, and, being duly sworn, testified as follows:

Examined by Mr. PARKINSON:

Q. 1. State you name, and whether you are the person of the same name who has before testified in this cause.

A. My name is W. A. Procter, and I am the person of the same name who has before testified in this cause.

Q. 2. What opportunities had you, in the year 1871, and for some years before and after that date, for knowing the standing in the market of candles of different manufacturers and the distinctions observed between them by the trade?

A. Being actively engaged in business in manufacturing and acquainted with the selling of candles, I was kept in constant knowledge of the prices and qualities of candles made by the different manufacturers in the United States.

1334 Q. 3. Did you, in the year 1871, and for some years prior thereto, know the candles put upon the market by R. G. Mitchell, of New York?

A. I do; I was acquainted.

Q. 4. How were they distinguished in the market from other grades of candles sold, as, for instance, from those sold by your company?

A. They were what was called high-grade candles and imitation sperm.

Q. 5. How were they with reference to the pressing of the fat acids from which the candles were made?

A. They were extra strong pressed—double pressed—hydraulic pressed.

Q. 6. Were you at that time, or prior thereto, making double-pressed candles?

A. I think not; if to any extent, a very limited one.

Q. 7. What were the candles generally in the market as your candles, double pressed or single pressed?

A. Single pressed.

Q. 8. Has the fact of their being double or single pressed anything to do with the price commanded in the market?

A. Oh, yes; the double pressed sell for considerable more than the other. The ordinary single-pressed candles are known as commercial candles—commercial grade candle. By single pressed we mean once through the cold press and then through the hot press; and by double pressing we mean remelting and crystallizing and again pressing through the hot press—extra strong press, heavier press than ordinarily used for hot pressing.

Q. 9. Is the market, and was the market, at and prior to 1871, for the double-pressed candles as extensive as that for the single pressed?

1335 A. No; nothing like as extensive for single pressed. The trade for double-pressed candles at that time was a small one and almost exclusively controlled by Mitchell. He made a candle that was thicker than the western candle and having a very hard pressed stock. He made a candle that was a close imitation to a sperm candle or a wax, and made a sale for them to a better class of customers; and they were burnt more in parlors and the like of that. The trade was not large enough for more than one manufacturer to engage in up to 1870; the demand was small.

Q. 10. What effect has the double pressing upon the cost of the article produced to the manufacturer?

A. Largely increasing its cost.

Q. 11. Was the demand mainly in the East or the West?

A. In the East; because, as we have often said, the East required and paid for better goods than the West were satisfied with. They paid the prices.

Q. 12. Have you, ever since that time, made any candles of that quality?

A. Yes, sir, we have; now me make very largely of them.

Q. 13. What was the change made in the manufacture in order to get these candles, as distiinguished from the candles you were making at that time?

A. By selecting the stock from the first hot pressing—the best fat—remelting, crystallizing, and repressing—the second process, second manipulation.

Q. 14. Was the process of saponification used by you any different where you were making this quality of candles from what it was where you were making the other quality of candles? I mean as between those which you turn off as double-pressed candles and those which you turn off as single-pressed candles, is
1336 the process of saponification used any different in one case than it is in the other?

A. No, sir; not any different. I don't see there is any difference at all. We have not changed the process, I mean.

Q. 15. You still make and sell the single pressed as well as the double pressed, do you not?

A. We do.

Q. 16. And at different prices?

A. At different prices.

Q. 17. And is the fat acid which is worked up into the single pressed obtained by the same process of saponification as that which is worked up for the double pressed?

A. It is.

Cross-examination by Mr. CHAMBERS:

X Q. 18. What is the difference in price between a double-pressed and a single-pressed candle?

A. From two to six cents a pound, according to the trade.

X Q. 19. The presses you use for pressing out the oleic acid from stearic acid are the hydraulic presses, are they not?

A. They are.

X Q. 20. What pressure per square inch is used in these presses?
A. That I can't answer.
X Q. 21. Do you know how many tons the press itself gives?
A. I do not.
X Q. 22. How many presses do you use—hydraulic presses, you understand?
WITNESS: At the present time?
COUNSEL: Yes.
A. I don't recollect. I don't keep the run of the factory at all now.
1337 X Q. 23. Do you distill the fatty acids which you make into the finest quality of candles?
A. We use both the distilled and saponified stock for the finer grades of candles.
X Q. 24. How many stills have you, sir?
A. Three.
X Q. 25. And what capacity of each still?
A. About 5,000 pounds, I think, they put in as a charge.
X Q. 26. Are these copper stills?
A. Yes, sir.
X Q. 27. Have they all apparatus attached for superheating the steam used?
A. Yes, sir.
X Q. 28. What is the nature of the material which you distill in these stills? What is it? That is what I mean.
A. It is fat acid—margeric acid.
X Q. 29. Where does this acid come from?
A. It comes from the saponifying house and the press-room.
X Q. 30. It is an acid made from neutral fat by digestion with hot water in your tanks, is it not?
A. With lime and water.
X Q. 31. Do you ever distill neutral fat in these stills?
WITNESS: Do you mean undecomposed fat?
COUNSEL: Yes, sir.
A. Not that I know of.

Redirect examination:

Q. 32. With which department of your business has your active connection been for some years past—the manufacturing or the selling?
A. Rather with the financial and buying—the buying of the material and the paying for it.

(Signed) WILLIAM A. PROCTER.

1338 It is agreed between counsel that copies of the Supreme Court transcript of record, which they now have, being incomplete, inasmuch as they do not contain all the drawings forming part of different exhibits printed therein, either party may supply such drawings during the continuation of the taking of testimony before the master, and such drawing, if offered and marked by the marked without objection, shall be considered as, *prima facie*, original drawings, whether certified or not.

Counsel for defendants here offers in evidence a drawing of the Tilghman patent of May 15th, 1860, No. 28315, corresponding to the specification found on page 261 and following of the Supreme Court transcript, and the same is marked "Def't's Exhibit Drawing Tilghman Patent, 1860."

Complainants' counsel, under the above stipulation, offers in evidence a copy of the drawings referred to in Prof. Jas. C. Booth's deposition and printed on pages 265 and following of the Supreme Court transcript of record, marked "A. W. B., Dayton."

It is admitted by the solicitor for complainant that the witnesses who took the data included in the resumé of the experiments given by John W. Hill, as stated by him, would, if present, state that the same are correct—and said data may be used in evidence as if proved by the several persons who noted the same.

Adjourned until 11 a. m. to-morrow.

1339 Hearing May 24th, 1883.

Morning Session.

WM. L. DUDLEY, called for defendants, being duly sworn, testified as follows:

Examined by Mr. PARKINSON:

Q. 1. What is your name, age, residence, and occupation?

A. My name is William L. Dudley; I reside in Covington, Kentucky; I am a chemist by profession; my business is in this city; my age, 25.

Q. 2. What experience, if any, have you had as a chemist especially in analyses, and what opportunities of becoming familiar with the practical application of chemical science?

A. I obtained my chemical education at the University of Cincinnati under Prof. Clark, and at the completion of that I was appointed as demonstrator of chemistry in the Miami Medical College four years ago, nearly five now, and a year later I was appointed professor of chemistry and toxicolology in that institution. I also held the position of demonstrator of chemistry in the Ohio Dental College. During that time I have been doing more or less chemical work, analyses, expert work, and been connected with the iridium discovery since its start; am secretary of the American Iridium Company for working this new metal, iridium. I am a member of the board of directors of the Ohio Mechanics' Institute and chairman of the committee on scientific and educational appliances of the Cincinnati Industrial Exhibition for 1883. I am a member of the German Chemical Society of Berlin, and a fellow of the American Association for the Advancement of Science.

1340 Q. 3. Have you been present at any tests or experiments upon a saponification of fats conducted by means of a coil apparatus at the works of the defendants, Proctor & Gamble, within the last few months? If so, please state when, under whose direction the mechanical part of the operation was conducted in each

case, and what, if any, connection you had with the operation or the testing and analyses of the products thereof.

A. I have been present at three tests of the coil apparatus of Mr. Tilghman, and my connection with it began about the early part of March last.

The first experiment was made on March 24th, in 1883. It was commenced at 10.54 in the morning of that day, after the fire of course had been started about 24 hours. until a gradual heating up had taken place. The temperature of the coil was that of the melted bismuth, and the pressure was 2,400 pounds per square inch. I collected four samples during this run, leaving the required amount of time for each sample to get through the coil—that is, when the charge was put in at 11.03 the first sample was taken. The color of that sample was nearly white, might be considered white, and the odor was that of acroleine, though not very strong. The temperature of the retort was bismuth, the temperature of the sample as it came from the cooler was 180 degrees Fahrenheit, and the pressure at the time that sample was taken was 2,200 pounds. On analysis, the sample showed 76.26 per cent. of free fatty acid, 23.74 per cent. of undecomposed fat.

The second sample was taken at 11.15. That was about the same color of the previous one; odor was acroleine, temperature bismuth; the temperature at the exit, or of the sample as it came from the cooler, 168 degrees Fahrenheit; pressure, 1,800; percentage of free fatty acid, 76.92; percentage of undecomposed fat, 23.8.

1341 The third sample was taken at 11.25. It was somewhat darker in color than the two previous. The odor was acroleine; the temperature bismuth, the same as before. Temperature at exit was 159 degrees; pressure, 2,000; percentage of free fatty acid, 78.12; and the percentage of undecomposed fat, 21.88.

The fourth sample was taken at 11.30. The sample was partly white and partly of a brown color, as the sample bottle was being filled as these two varieties came out. The odor was acroleine; temperature, bismuth; temperature at the exit, 156°; pressure, 2,000; percentage of free fatty acid, 80.72; percentage of undecomposed fat, 19.28.

Following is a copy of my tabulated statement:

1342 "*Tilghman Coil Apparatus, Trial No. 1, March 24th, 1883, at Procter & Gamble's Factory, Cincinnati, O.*

No.	Time.	Pressure, lbs.	Temp. of retort.	Temp. at exit.	Color.	Odor.	Analysis.	
							Per cent. of fatty acids.	Per cent. of undecomposed fat.
	A. M.							
1	11.03	2,200	Bismuth melted.....	180	White.....	Acroleine.....	76.26	23.74
2	11.15	1,800	"	168	"	"	76.92	23.08
3	11.25	2,000	"	159	Darke.....	"	78.12	21.88
4	11.30	2,000	"	156	Wh't- to Br'n.....	"	80.72	19.28"

1343 At this time, 11.50, on examination, it was found that the coil had broken, or at least we noticed that the fat was getting into the fire, and the experiment was then closed, the fire withdrawn, and the coil allowed to cool down for examination.

The following Monday, I think it was, the coil side of the furnace was taken out and an examination was made—put in a light—I was there at the time—but we could see no fracture in the coil, and we explained it probably from the fact that the material was being forced through the pores of the cast iron, and in that way getting into the fire.

This result I have copied from notes in the form of the table, of which a copy is herein given. My statements were given with my original notes before me.

The second trial was made May 8th, 1883, after having made this thorough examination into the cause of the leak during the trial of March 24th. The operation was begun at 11.30 and continued until 1.05 p. m. During that operation I took 11 samples.

I give here a copy of a table of results, which table was made from my notes made at the time. It shows the facts as therein indicated, and I here insert it as part of my testimony. It is as follows:

1344 "*Tilghman Coil Apparatus, Trial No. 2, May 3rd, 1883, at Proctor and Gamble's Factory, Cincinnati, O.*

No.	Time.	Pressure, lbs.	Temp. of retort.	Temp. at exit, F.	Color.	Odor.	Analysis. Per cent. of fatty acids.	Analysis. Per cent. of undecomposed fat.
	A. M.							
1	11.30	1,800	Tin begins.....	135	Yellowish.....	Fatty.....	7.92	92.08
2	11.50	2,000	" "	146	Whitish.....	"	7.84	92.16
3	12.00	2,000	" melted.....	140	"	"	8.11	91.89
	P. M.							
4	12.10	2,100	" "	136	"	"	8.38	91.62
5	12.20	2,500	" "	145	"	"	13.02	86.98
6	12.30	2,000	Bismuth begins.....	147	"	Acroleine.....	74.25	25.75
7	12.35	2,000	" melted.....	172	"	"	78.82	21.18
8	12.40	2,000	Lead melted.....	120	Darker.....	"	80.16	19.84
9	12.45	2,100	" "	120	"	"	76.49	23.51
10	12.50	1,500	Nitrate of potash.....	118	Yellowish	" very strong.	81.02	18.98
11	1.05	2,000	" "	104	"	" " "	80.36	19.64"

1345 It will be noticed in that that the temperature of the retort at the start was about that of tin. Tin was beginning to melt, and the product that came over had a decided odor of fat, as indicating that it was not completely decomposed, and, as the analysis shows, that very little decomposition had taken place. This continued until the bismuth began to melt; then there was a rapid jump from 13.2 per cent. of free fatty acid to 74.25. From that on it runs tolerably evenly, and the tenth sample was taken at the temperature of nitrate of potash—that is to say, the nitrate of potash was melted—but, in all probability, the temperature was

higher than the melting point of nitrate of potash; and in the two samples, tenth and eleventh, taken with the nitrate melted the percentages were 81.2 and 80.36 of free fatty acid. That seems to be the highest result which we have obtained, but at the same time the odor of the acroleine was very strong, and it got so powerful that the workmen could not stand the atmosphere in the building. Then, at 1.05, the experi[ment] was abandoned on account of the acroleine which was given off from the product, and also from the leakage of the joints in the outside pipe. The leakage was very bad, and the smoke and fumes and the odor of the acroleine were very strong.

The third trial was made May 11th, 1883, in the presence of President Morton and Dr. Endemann. The experiment was begun at 3.13 p. m. and continued until 4.55 p. m. I have the temperature and pressures. Dr. Morton and Mr. Endemann made the analysis. I made no analysis. I simply made a memorandum of the temperature at which they took their samples.

Q. 4. Did you witness and note their analysis at the time, or did you simply get the results from them?

A. I have not the results of their analysis; I have simply the time, pressure, and temperature at which the samples were taken. Here it is:

1346

No.	Time.	Pressure.	Temp. of coil.	Temp. at exit.	Color.	Odor.
1	3.26	2,100	Tin	178	White	Acroleine, slight.
2	3.32	2,000	"	.....	"	Acroleine.
3	3.37	1,900	Bismuth just melting	188	Whitish	"
4	3.42	1,400	Bismuth	191	"	"
5	3.47	1,950	"	162	"	"
6	3.57	2,000	"	150	"	"
7	4.	1,600	Tin melted	165	"	"
8	4.26	2,000	Lead	168	"	"
9	4.35	1,900	"	179	"	"
10	4.55	2,100	"	118	"	" "

1347 That is all. The odor of acroleine increased as the temperature ran up; and the color, of course, when I say whitish, it was approximately of a white color. At that time, 4.55, the joints, which had been renewed since the last trial, began leaking again, and the experiment was discontinued.

Q. 5. Under whose supervision were the mechanical parts of that process conducted?

A. Under Mr. John W. Hill, mechanical expert.

Q. 6. All of them?

A. All the tests. He was present at all of them and watched the pressures; and, at the last test, we found that it would be necessary to have a man watch the pump, especially skilled in that business. Mr. Manning was brought down for that purpose. I watched the samples—collected the samples; also took note of the pressure, and

watched the temperature of the coil—that is, whether it was melted tin, lead, bismuth, and so on.

Q. 7. Did you make at the time a memorandum of the items to which you have testified? If so, have you your original memoranda, and are the items given by reference to that?

A. I have reviewed them, and I have made the statement from the memorandum as I have them. I made the memoranda of everything that took place. I have them with me, and have reviewed them.

Q. 8. What, if any, care was taken to obtain a correct and reliable analysis in respect to all the particulars given?

A. All the precautions which are at present known to chemists were taken, and the analyses made, and of each sample duplicates were taken, in order to show that the results were correct.

Direct examination closed.

1348 Cross-examination by Mr. CHAMBERS:

X Q. 1. In your trials of the 24th of March and the 3rd of May, did you obtain glycerine as well as fatty acids?

A. Yes; we obtained glycerine as well as fatty acid. I made some tests of the glycerine; estimated in some few samples, approximately, the amount of glycerine, and it did not run anything like we would consider an even manner, because sometimes the sample, as collected, would contain a great deal of water, and at other times it would be quite thick with very little water; but I found in the samples where decomposition of the fat into fatty acid had taken place that there was glycerine.

X Q. 2. How was it in the last experiment at which you assisted in regard to the glycerine?

A. I made no test of that. I made no chemical test in the last experiment. The samples were collected directly by Prof. Morton and Dr. Endemann, and analyzed by them.

X Q. 3. Did you notice whether the material came from the coil in the same regular manner that it did in the other two experiments?

A. The results seemed to be about the same in that regard; the samples had the same appearance, and it was about the same sort of a flow.

X Q. 4. Please describe the extent of the irregularity or variation of the material as it came from the coil.

A. In some cases the flow would altogether cease for a few seconds. Then it would begin again, sometimes running watery, having a turbid appearance, and then it would sometimes change from that to a thick, curdy mass, which would be squeezed out through the opening. The changes, as a general thing, were not very sud-
1349 den—that is to say, it would not go by sudden impulses or spurts; it would run out, but vary in that way; sometimes it would close off; then it would start again, run faster or slower, as the case might be. Now, then, I think, on one or two occasions, where the pipe seemed to get clogged, it would throw out the mass

with some considerable force. We were more liable to notice that in the beginning of the operation than when we got under way.

X Q. 5. Did you make any tests or experiments to ascertain the extent of the variation?

A. I made no such experiments, but from time to time Mr. Hill, the mechanical expert, had the product weighed a certain length of time to show that the average amount of flow was about that required in the specification of the patent.

X Q. 6. Did you at any time ascertain the proportion between the fat and water in the material as it came from the coil?

A. I made no such experiments. My analyses were on the proportion of fatty acid and undecomposed fat in the product of the coil, and not the proportion of this combination with the water.

Redirect examination:

Q. 7. In your statement of the per cent. of fatty acids obtained, is the per cent. given that of the fat acid contained in the product which was separated from the glycerine, or that of the entire neutral fat?

A. The results there are the percentages of undecomposed fat and free fatty acid in the product after the glycerine and water had been removed.

(Signed) WM. L. DUDLEY.

Recess till 2 p. m.

1350 Hearing May 24th, 1883.

Afternoon Session.

JAMES N. GAMBLE was called on behalf of defendants, and being duly sworn, testified as follows:

Examined by Mr. PARKINSON:

Q. 1. State your name, and state whether or not you are the person of the same name who has testified before in this cause.

A. My name is James N. Gamble, and I am the person of the same name who testified before in this same cause.

Q. 2. Have you at any time during the last few months prepared and sent to President Henry Morton, at Hoboken, any fat acids? If so, what were they, how were they prepared and sent, about when, and what, if anything, accompanied them to identify them?

A. About April 11th, or a day or so after it, perhaps, I sent to President Morton a sample of the product from a charge of tallow which was run, as we say, in our digester on the 11th of April; the charge consisting of 7,000 pounds of tallow, 70 pounds of lime, and our usual quantity of water—somewhere about 3,500 pounds—and it was run 11 hours. I subsequently sent a second sample to President Morton of a charge run on April 13th, the charge consisting of 7,000 pounds of tallow, 70 pounds of lime, about 3,500 pounds of water, and was run 8½ hours. I subsequently sent on about April 19th or 20th to President Morton a sample of a charge which was run in our digester on April 19th, the charge consisting of 7,000

pounds of tallow and about 3,500 pounds of water, without lime. This charge was run 12½ hours. In all these cases a second charge of water was used. The actual occupation of the digester was one-
half hour longer—it takes a quarter of an hour to run out
1351 and a quarter of an hour to run in. I have not noted the time of first water, but my impression is the last water was run, in each case, one hour. In each case the pressure by our gauges was about 150 pounds. I wrote, in sending each sample, to President Morton, stating substantially how the sample had been produced. These samples were sent by express to President Morton; the letters went by mail. The letters and samples went at the same time. I am not sure they all went by mail; one or more may have been inclosed with the samples.

Q. 3. Did the letters correctly state the character of the samples at the time?

A. I believe they did. I marked the samples. The quality of fats used was tallow—fair tallow.

Q. 4. Can you state about the heat?

A. I stated that each charge was run at about 150 pounds steam pressure by our gauges.

Q. 5. Were you present at your factory on or about May 11th, 1883, when fats were decomposed into fat acids and glycerine in your tanks under the supervision of Prof. Morton and Dr. Endemann; if so, can you state what was used in these experiments?

A. On May 10th we placed in digester No. 1 at our factory 7,000 pounds of tallow and about 3,600 of water, and also in digester No. 2 we placed 7,000 pounds of tallow and 70 pounds of lime and about 3,600 pounds of water. These two charges were digested under the charge of Prof. Morton and Dr. Endemann. The tallow was of good quality—prime tallow.

Q. 6. Were these the only experiments of that kind made under the supervision of Prof. Morton and Dr. Endemann in your factory, so far as you know?

A. I believe they are the only ones of this kind; they were the only ones made in our digester. I ought to explain a little discrep-
ancy in regard to water between what I have said and what
1352 has been stated heretofore. I stated the amount of water to Prof. Morton and Dr. Endemann when they were with us under a misapprehension in regard to the position of the gauge-pipe, and their testimony was based on my statement to them of what we had in the digesters, but upon a later examination I found that the gauge-pipes in both digesters were arranged alike. I was under a misapprehension, because the diaphragm in one case had been placed 18 inches higher than in the other, and I thought that the gauge-pipe extended the same distance below the diaphragm in each case. It was under that misapprehension that I stated that the quantities of water were different in the two digesters, but I found that they were alike.

Q. 7. Have you the registration of the gauges in those experiments?

A. I have not the registration of the gauges. I have not of the

gauge used upon the digester. The gauge that was used upon the digester in this experiment was subsequently taken to Post & Co., of this city, and tested in comparison with the standard gauge and found to be too heavy—that is, when it indicated 150 pounds the pressure really was 131 pounds. I have a copy of the whole registration of their test. If you wish it I can give it to you. When the indication of our gauge, Procter & Gamble's gauge, was—

130	the correct figures were		115½
135	"	"	118
140	"	"	123
145	"	"	127
150	"	"	131
155	"	"	137
160	"	"	140
165	"	"	144
170	"	"	147
175	"	"	153

Q. 8. Where did you have this test made?

1353 A. By Messrs. Post & Co., dealers in railway supplies and steam supplies and men who test gauges.

Q. 9. State whether or not this gauge was the same commonly used with your digester, and by which the pressure was taken in the various experiments made with this digester, and also in your ordinary business operation with them.

A. It is not. It is one we placed upon the digester, especially for convenience of observation in the experiment. We ordinarily run our digesters by gauges that are attached to the steam boilers.

Q. 10. Was or was not this the gauge used in the experiments made in your factory with the coil apparatus?

A. It was not.

Q. 11. What, if any, efforts have you made to procure a successfully operative apparatus made in accordance with the Tilghman patent?

(Question objected to as ambiguous, the patent not being for a machine, but for a process.)

Objection overruled.

A. During last summer I applied to J. H. Manning, a steam-fitter in our city, a man who does good work and has a good reputation, putting into his hands a copy of the patent, and asked him to make an apparatus such as was described there, or that would fulfill the conditions necessary. He made first an apparatus of pipe one inch in diameter, double extra strong pipe, 1¼ inch outside, containing, I believe, some 420 feet, and had the same surrounded with cast iron, the whole weighing, when finished, about six tons. This he placed in our factory in the furnace which was built for it and heated it, pumping water through it, and in a very short time it cracked,

1354 made quite a report, I believe, the cracking, although I did not hear that. We made later, after having called in J. W.

Hill, a mechanical engineer and steam expert, another coil, after Mr. Hill's drawing. The instructions to Mr. Hill were to prepare the coil in accordance with the patent, and leaving nothing undone that would make it a thorough piece of mechanism. This coil cost us about $1,400.

Q. 12. Did you take any precautions to obtain a high quality of apparatus?

A. My instructions to the engineer and to the steam-fitter were to make it as thoroughly as they could—suitable for the purpose and in accordance with the patent.

Q. 13. Were you present at any test subsequently made with either of these coils?

A. On the 24th of March this second coil was used for a time. I was present during the operation of it. We pumped an emulsion of tallow and water through it, and after a little time found that the discharge was slow, and upon examination found that the pump was leaking at the stuffing-box, and we attempted to pack it, and while we were packing it saw that there was some of the fat escaping into the fire. The cause of the leaking at the stuffing-box we concluded was that we had heated the pump and the suction and delivery pipe too hot. The packing in the pump being leather gave way under that heat and the action of the fat. We then removed the pump, and some experiments were made as to what packing would be suitable. The conclusion reached was, I believe, that cup-leather would be the best packing, and that the temperature of the fat and water must be kept somewhere about 110°. There was in this operation some odor of acroleine—considerable odor of acroleine developed. That was the first test that we made with this digester in which we passed tallow through. On the 3rd of May we made another experiment. Mr. Hill was present, and looked particu-
1355 larly after the temperature of the coil and the pressure. Prof. Dudley was present and took samples of the product. Mr. Donnelly weighed the charges of fat and water. Our engineer, Mr. Cabe, attended to the fire and pump—that is, he looked after the fire; did not do the firing. Mr. Cooper Proctor took the temperature of the fat as it was discharged from the condensing worm. Mr. A. Proctor took the temperature of the overflow from and the water to the condenser. We had, also, two men to stir the mixed fat and water, and a third man to relieve them occasionally. The temperature of the tallow at the start was 115°. We began at about 11.27 with a pressure of 2,050 pounds. The first delivery of fat was about 11.41. At 12.12 the product was much thicker than at first. At 12.20 it was very thick. At 12.35 the bismuth was melted and there was a strong odor of acroleine. At 12.42 the nitrate of potash was melted, the product was very thick, and the odor of acroleine very strong. We continued this operation not quite 2 hours. A leak at the flange in the discharge pipe and at the top of the condenser grew rapidly worse, and there was so much of the acroleine that we quit work. During the progress of the experiment several tests of the speed of discharge were made by weighing the product. The product was all received in one vessel, and it was of a white

color; had a strong odor of acroleine; had in a great deal of undecomposed fat, and was wholly unfit for use for candle purposes. On the 11th of May another experiment was made with this apparatus, at which there were present President Morton, Dr. Endemann, J. W. Hill, Professor Dudley, J. H. Manning, and others to assist. The coil had been heated over night and water was kept flowing through it. At 3.05 the tin was softening, and at 3.13 we began to pump the fat through it under a pressure of 2,000 pounds, the tin melting; at 3.26 we had the first discharge of the product with
1356 the pressure of 2,200 pounds tin melted and we noted the odor of acroleine; at 3.36 bismuth melted; pressure, 1,800 pounds. As soon as the melting of the bismuth was noted the barrel into which the product had been discharged was removed and another substituted. This was done in order to secure the product which had been made whilst tin was melting. At 3.57 tin was melted, the pressure was 2,000 pounds, and the second portion of the product was removed, this having been produced while bismuth was melting. At 4.12 the tin was still remaining melted, and pressure 1,900; a third portion of the product was removed, this having been produced while tin was melted. At 4.18 lead was softening. At 4.25 it was melted. At 4.30 a further portion of the product was removed, this having been produced while load was melting. At 4.55 the pressure was 2,100, temperature at the discharge was 118°, and a fifth portion was removed. The acroleine from one or two leaks had become so considerable that the process was discontinued; it was not a fit place for men to work.

Q. 14. What did you do with the barrels containing samples taken from the coil at different stages of the operation on May 11th?

A. These barrels were marked distinctly by cutting 1, 2, 3, 4, 5, and turned them over to Mr. Donnelly to melt and cleanse the material and pan it in our pans that we ordinarily put our candle material into.

Q. 15. At what stage of the operation was the condensing barrel marked 1 taken?

A. It was taken at 3.36, just when bismuth was melting or melted.

Q. 16. State the same with reference to 2, 3, 4, 5.

A. Barrel No. 2 was taken at 3.57 when the temperature had gone back to the melting of tin; it had been produced while bismuth was melting. Barrel No. 3 was taken at 4.12, and had
1357 been produced while tin was melted. Barrel No. 4 was taken at 4.30 and had been produced while lead was melted, and barrel No. 5 was taken at about 4.55.

Q. 17. What was the quality of fat used for all these experiments?

A. Prime tallow.

Q. 18. Was any of the fatty acid obtained from any of these experiments with the coil apparatus fitted for the uses to which fat acids are ordinarily put by you?

A. None of them was fit for such use.

Q. 19. Making no allowance for the extra wear and tear of machinery, or liability of breakage due to high pressure, or for the in-

ferior quality of product, how much would it cost you to carry on the process of decomposing fats with the coil apparatus as compared with the old mode of decomposition?

A. About ten times as much.

Q. 20. How many workmen are required for the operation of decomposing the fats as ordinarily carried on by you with your digester?

A. We have four men employed.

Q. 21. What is the work of each?

A. One man to melt the tallow, one man that attends to running the digesters, and one man attends to the neutralization, and one man attends to the boilers. They do some other work, attending to the evaporation of glycerine and some other work connected with it; but we have these men employed steadily.

Q. 22. How much fat acid is yielded in the operation as carried on by these four men?

A. I can give you an average. The amount of neutral fat treated as we ordinarily run is about 1,625 lbs. per hour, counting 132 hours to the week. Our week's work is 33 digesters of about 6,500 lbs. We make eleven charges in each digester in the week.

1358 (Examination of the witness was suspended to enable the complainant to examine a witness, and was resumed Friday morning, May 25th, 1883.)

Hearing, May 25th, 1883.

Morning Session.

Examination of JAMES N. GAMBLE continued.

By Mr. PARKINSON:

Q. 23. Have you made any tests to ascertain the yield of fat acid from the process used by you as referred to in your answer on pages 18 and 19 of the transcript of the Supreme Court record; if so, with what results?

A. During July, 1882, we ran in our digesters ten charges of prime tallow, using 69,960 lbs. of raw tallow, digesting at 200 pounds pressure, using one per cent. of lime and our usual quantity of water, about 3,500 pounds to the charge—that is, with two charges of 3,500 pounds to each charge of the digester—and obtained a total result of 66,022 pounds of fatty acids, possibly mixed with neutral fat; glycerine is not included in that. This consisted, as we got it, of 65,036 pounds of clear saponified tallow and 468 pounds of darker saponified tallow and 153 pounds that was mixed with settlings—these last two items were from the lime tub—and 365 pounds of skimmings, containing some glycerine; this last was from the concentrating tanks that we use for concentrating the glycerine. These all taken together make 94.37 per cent. of the tallow employed.

1359 I cannot state the duration of the treatment. I have no note of that at present. It was our usual time simply.

Q. 24. State approximately.

A. It was probably nine hours—eight hours with the first water and one with the second; it was about that.

Q. 25. What efforts, if any, did you make to obtain a fair test?

A. I instructed the men who were doing the work to do it carefully and well in order that we might obtain an accurate result as to the yield; took every precaution that I could think of to have everything carefully done.

Q. 26. Were the men informed, so far as you know, of the use to which the results obtained were to be put or might be put?

A. They were not, so far as I know.

Q. 27. State whether or not the test was, in your opinion, conducted with sufficient thoroughness and under such favorable circumstances as to secure as favorable results as would be obtained in your process of manufacture; or, if more or less so, please state that.

A. I think it was conducted so as to obtain as favorable result as could be obtained. That was our aim.

Q. 28. Was there, so far as you know, anything entering into it to decrease the yield of fat acid below that ordinarily obtained by you?

A. There was nothing that I know of.

Q. 29. What heat or pressure are you commonly using in your digesters?

A. We are now using about 150 pounds steam pressure by our gauges.

Q. 30. How long have you been using that?

A. Perhaps a month or little more.

Q. 31. What were you using prior to that time?

A. We were using 200 pounds of steam pressure by our gauge.

Q. 32. How long had you been using that, about?

1360 A. We had been using that for a number of years; can't say as to how long.

Q. 33. Prior to that time had you used more or less?

A. We had used, prior to that time, 250 pounds.

Q. 34. Why have you fallen, first to 200 pounds, then to 150?

A. Well, we concluded we obtained as good results with 200 as we did with the 250, and we think we are doing as good work now with 150 as we did with the 200.

Q. 35. What are the several treatments through which the fat passes from the time you purchase it until it passes out of your hands in its marketable condition?

A. We purchase a variety of fats in the market, according to our best judgment of what is suitable for our uses. We melt out this fat first and wash it a little with steam and water. It is then transferred to the digester and decomposed by our usual way, with water and lime. After the decomposition the glycerine water is blown out by steam pressure into suitable vessels. The fat acids are also blown ont into another vessel, and then neutralized—that is, the lime extracted by means of sulphuric acid in a lead-lined vessel. The fat acids, then, are carefully washed and settled, and drawn into enameled or granite ware pans for cooling. At the time of this accounting the process of cooling was a little different, being done in tubs. After being carefully and gradually cooled, so as to admit of the

most perfect crystallization we can obtain, the cakes which had been formed in the pans are wrapped in woollen cloths, placed in a hydraulic press, pressed cold, and transferred to a hot press, and pressed again, hot. What is pressed out from these two presses is melted and cooled and submitted to a different method of pressing. The cakes thus obtained are remelted and repanned and repressed, hot and cold. The hard mat-
1361 ter, stearic acid chiefly, obtained from these presses is then melted and clarified in lead-lined tubs, and molded by skilled workmen in candle machines, which are patented, or were, at the time of this accounting, under a patent. The candles after being drawn from the molds are exposed to sunlight for bleaching, and then transferred to the packing-room, and are cut to the proper length for the weight required; are cleaned, polished, and packed, and when packed are ready for the market, which has to be found for them. The candles thus prepared have to be placed upon the market, customers have to be found and credits given, and trade which has been the result of being in this business for a great many years enables us to place these candles upon the market.

Q. 36. How long has your company been doing this business of making candles?

A. We have been in business since 1837. This star candle business we have been in since 1850.

Q. 37. Were you making candles prior to 1850?

A. We were making candles from tallow, neutral tallow, previous to that time; the firm was; I couldn't say "we" were.

Q. 38. From 1837 down?

A. From 1837 down, making candles.

Q. 39. You spoke yesterday of the cost of the coil apparatus lately used in your factory. Did the cost mentioned refer to both coils successively put in or to one?

A. The cost mentioned referred only to the second coil.

Q. 40. Did or did not this include any expenses you were put to for expert services in connection with getting up or testing the coil?

A. This did not include any cost of expert services.

Q. 41. Have you any memorandum of the cost of the first?
1362 A. I have not.

Q. 42. About how would it compare with the second—I don't care for accurate figures—about how?

A. If we should include all the connections, pump and condenser, with the first, it would have cost more than the second.

Q. 43. Did or did not the cost given for the second include these?

A. It did include these, the pump and condensing coil in connection with it.

Q. 44. You mean that the $1,400 or thereabouts named in connection with the cost of the second, included what was paid for the pump, condensing device, etc.?

A. I mean that; those things were included in the $1,400. My reason for answering in this way is these things were purchased with the first coil, and applied to and used with the second coil, and that

the cost of the first, if it included those, would be rather more than the second coil.

By Mr. CHAMBERS:

Q. 45. You mean, do you not, that the cost of the coil and casting of the first apparatus was more than that of the second apparatus?
A. I do.

The direct examination of the witness is closed, Mr. Parkinson stating that he may wish to recall the witness upon some further points at the taking of other depositions before his case is closed.

Cross-examination by Mr. CHAMBERS:

1363 X Q. 46. Did you have any chemical analysis made of the ten charges of fat which you have testified were made and carefuly weighed in 1882?
A. No, sir; we did not.
X Q. 47. They were well decomposed, were they not?
A. They were well run, as we ordinarily run them.
X Q. 48. The material was fitted for manufacturing purposes?
A. It was prime tallow.
X Q. 49. As completed?
A. Oh, yes. The result—the product was fit for manufacturing purposes.
X Q. 50. Is it your custom to have a chemical determination of the amount of fatty acids in the product of your digesters made?
A. It is not.
X Q. 51. How do you know whether it is fitted to manufacture into candles or not?
A. We judge as it comes from the digester, by cooling a sample and noting its crystalline appearance. We judge again when it is cooled and ready for pressing, by pressure of the thumb on the cake; if the oil exudes readily, and the stock which remains under the thumb is white, we conclude that it is in good condition. We judge further, when we get into the press, that if the oil runs out freely and the stock does not warm the bag, that it is in good condition. "Warm the bag" means the stock presses out through the meshes of the cloth, like maccaroni.
X Q. 52. If stock does not comply with these practical tests of fitness for candle making, you would reject it for that purpose, would you not?
A. We can't quite reject it.
X Q. 53. Reject it for that purpose, my question was?
1364 A. It has to—when it gets in it has to go through in some way or other; that is the trouble. We press it very severely, take out all that is inferior that we can, and use the remainder—a portion of it—mixed with better material. When we have it thus saponified and prepared, it can not very well be turned over to other uses. The result is, of course, an inferior candle.
X Q. 54. If the stuff won't crystallize, if you could not press oil out of it with the thumb in the manner you have described, but, on the contrary, the thumb should slip over the surface of the material

as it would with raw grease, could you make a star candle out of it without intermixing it with a very large proportion of good material?

A. A star candle could not be made from such material without a very large admixture of good material, and, in my judgment, it could not be made at all. The stuff would have to be worked over if it was so bad as indicated in your description in the question.

X Q. 55. This would be true, would it not, no matter what a chemical analysis might show to be the decomposition of such material?

A. I think it would.

X Q. 56. Has it ever been the custom of your firm to have the decomposed fatty matter chemically analyzed as a practical means of determining its fitness for manufacturing candles?

A. No; it has not been our custom.

X Q. 57. Besides the chemical analysis recently made by Mr. Morton and Mr. Endemann, have you had other analyses made of your decomposed fats at any time?

A. I do not recall any analysis made.

X Q. 58. How many stills have you in your works?

A. We have four.

X Q. 59. Please describe how they are constructed and for what purpose they are used?

1365 A. They are copper stills, about seven feet in diameter or thereabouts, and perhaps a little greater depth than seven feet. The bottom is slightly rounding, or dished, and has a pipe extending from the middle of it downward; the top is also rounding, convex, having an opening about 18 inches in diameter, and above which, attached to a short neck, is a goose-neck, reduced from 18 inches to 7 inches in diameter, and connecting with a seven-inch pipe which connects with a series of condensing pipes. We have a fire placed underneath. The whole is set in brickwork. We have adjacent to the still a coil of superheating pipe in the furnace—1½-inch pipe—perhaps 200 feet of pipe. We bring steam into this coil from the boiler. After it has been heated in the furnace it is carried into the still, brought down to the bottom of the still, and distributed through a six-arm distributer pierced with holes. These stills are used for purifying fat acids from which we have removed the glycerine by the action of water and lime in our digester.

X Q. 60. Will you have a drawing of one of the stills, together with its attachments, prepared at my cost and given to the master, to be by him marked for identification?

A. I will.

(Said drawing will, at the proper time, be marked "Complainant's Exhibit Defendants' Distilling Apparatus.")

X Q. 61. Have you ever used the stills or any of them for the purpose of distilling neutral fats in a current of steam?

A. We have never used them for distilling neutral fats in a current of steam. The only approach to that that we ever used them

for was the distillation of what was pressed out in our hot presses, which might contain a portion of neutral fat.

1366 X Q. 62. This material had, before being so treated, been subjected to your usual process of digesting with water, had it not?

A. It had if the digestion was imperfect. What was pressed out from the hot press might contain some neutral fat.

X Q. 63. Did you ever treat in these stills, and by the process mentioned, any raw neutral fat? I mean fat which had not previously been subjected to any process for decomposing it.

A. We never did.

X Q. 64. Why did you never treat such raw fats in this way?

A. I have thought several times that we would do so; but, for one reason or other, it has been crowded out or neglected.

X Q. 65. Do you know of anybody who has made a practical success of such treatment of fats?

A. I do not.

X Q. 66. How long have you been using your digesters at the pressure which you state you are now using them?

A. About a month.

X Q. 67. Have you ever treated neutral fats with water alone in your digesters, at a pressure of, at or about, 250 pounds per square inch, and a corresponding temperature?

A. I think we have, but I can't answer definitely as to when or what results were obtained or the time that we continued the operation.

X Q. 68. Was this done within the last two years?

A. I don't think we did this within the last two years.

X Q. 69. Three years?

A. Well, I think I answered before that I could not speak at all with regard to the time. I have a sort of an indefinite recol-

1367 lection of having that thing done, but when, and what results were obtained, I cannot answer now.

X Q. 70. Does your firm manufacture washing soap from neutral fat?

A. We do.

X Q. 71. What is the process of this manufacture?

A. We buy soda ash or caustic soda, dissolve and causticize the former and dissolve the latter, making lyes, and these bring into contact with melted fat in a large kettle heated by steam, and continue the heating and agitation by steam until there is a saponification effected; remove the excess of water by the addition of salt, which dissolved in the water forms a liquid in which the soap is not soluble; the soap rises to the top; the salt lye settles to the bottom and is removed; further additions of lye are made and the boiling is continued, and the soap is passed through other processes that we deem necessary for its completion.

X Q. 72. You add sufficient lye to form a salt or soap with all the fats treated, I understand, and make a complete saponification?

A. We make a saponification, but subsequently add more lye, which, in technical phrase, "strengthens" the soap.

X Q. 73. Do you make a complete saponification of the fat with the first quantity of alkali used?

A. It is not complete, in the sense of making a washing soap, nor am I sure that it is complete in a chemical sense.

X Q. 74. You make two successive applications of lye, then, to completely saponify the fats treated?

A. We do for making soap.

X Q. 75. Is it not the fact that you add the alkali to the fat in more than two successive applications?

1368 A. In ordinary practice it may be so. If we had a second portion of fat it will require, of course, additional lye. We might not be able, on account of the capacity of our kettle, to take all the material in at one time, and, practically, that is the rule. I mean that we add a second portion of lye to meet a second portion of fat. That is not clear, because you may think it refers to the second portion I spoke of awhile ago.

X Q. 76. Don't you sometimes treat a whole charge of fat at once; I mean don't you put into your tubs all the fat you intend to put into them at the beginning of the operation?

A. Rarely, if ever. I don't recall when we have done such a thing.

X Q. 77. When you add the first lye to the fat do you use the full quantity of lye necessary for the saponification of that fat?

A. We add sufficient lye to, as we say technically, "kill it"—destroy any greasy feeling and saponify it to that extent.

X Q. 78. After the stock is what you call "killed" what is the next step?

A. If all has been killed the next step is to, as we call it, "strengthen"—add lye, to completely saponify or to make an alkaline soap.

Redirect examination:

Q. 79. In your treatment by distillation do you complete the distillation of the charge in the still before further feeding the still, or do you supply it from time to time before the charge is exhausted?

A. We do not always exhaust the charge. We draw in the fresh supply when it has been almost exhausted at times; and, perhaps, after one or two or several distillations we then draw off the residuum.

1369 Q. 80. Is it your custom to supply further material two or three times after the distillation has been commenced before you draw off the residuum and recharge the still?

A. That is our usual custom—to do as I have described.

By MASTER:

Q. 81. How did the fatty acids obtained from the ten charges mentioned by you compare in quality with the samples sent to President Morton, as stated by you?

A. I can't answer that question. I don't know.

By Mr. PARKINSON:

Q. 82. Why can't you answer that question?

A. I don't recall the exact appearance of the ten charges that were run—of the material that was produced by those ten charges.

Recross-examination by Mr. CHAMBERS:

X Q. 83. The material spoken of as having been distilled in your redirect examination was not neutral fats, but hot-pressed grease and similar substances, I understand?

A. The material is grease from which we have removed the glycerine by decomposition in the digester with water and lime.

X Q. 84. In distilling this material do you obtain any glycerine in the condenser?

A. If the glycerine appears there we do not obtain it; the water that comes over runs away.

X Q. 85. You don't know whether there is any glycerine in it or not, I understand?

1370 A. I don't know of any being in it.

X Q. 86. In your distilling process how many pounds of fatty acids do you distill before emptying out the residue?

A. Our charges in the still are about 6,000 pounds; we may run one, two, or three before running out the residue; depends a little upon the nature of the material used.

X Q. 87. Suppose you were running three such charges how long would this distilling operation take?

A. From 40 to 48 hours.

X Q. 88. What would be the greatest amount of the water used in this process in proportion to the fat acid distilled. I mean how much water condensed from the steam?

A. I have no means of ascertaining. I don't know.

X Q. 89. Why do you not carry on this process continuously for more than three charges?

A. The residuum becomes somewhat thicker.

X Q. 90. What do you mean by "thicker," sir? Do you mean that the material will not distill properly after this amount has been used?

A. The material that would be distilled would be liable to be darker in color.

X Q. 91. Toward the close of such an operation, then, the material is darker than at first?

A. It is always so in distillation.

X Q. 92. Is there any other difference between the material you obtain at the close of the distillation and that obtained at the beginning?

A. It is liable to have a stronger odor.

X Q. 93. What kind of an odor?

A. Acroleine.

X Q. 94. After, say, three charges have been used consecutively, how much residue do you find in your still?

1371 A. I can't say definitely.

X Q. 95. Approximate it, Mr. Gamble.

A. I can't answer with any sort of correctness, I think.
X Q. 96. Is it 100 pounds?
A. I should suppose it would be more than one hundred.
X Q. 97. 200?
A. Yes; I think it would be more than 200.
X Q. 98. Three?
A. I can't go any further.
X Q. 99. Could you say it was not more than 500?
A. I could not.
X Q. 100. Could you say it was not more than 1,000?
A. I would be very certain that it was not.
X Q. 101. What did you do with this stuff?
A. Redistilled it.
X Q. 102. With fresh material, I suppose?
A. No; alone. We draw it from the bottom of the still, and place it in an iron still, where we subject it to the action of superheated steam and distill off what will come over.
X Q. 103. What do you do with the residue in this iron still?
A. That is drawn off and sold as candle tar.
X Q. 104. In carrying on this last distillation in the iron still, do you obtain the odor of acroleine?
A. We do.
X Q. 105. Strong?
A. Pretty strong; stronger than in the other operation.
(Signed) JAMES N. GAMBLE.

1372 JOHN M. DONNELLY, called for the defendants, being duly sworn, testified as follows:

Examined by Mr. PARKINSON:

Q. 1. State your name, age, residence, and occupation.
A. My name is John M. Donnelly; age, 54; residence, Cincinnati; occupation, employed by Procter & Gamble.
Q. 2. In what part of their business?
A. I am general utility man.
Q. 3. About the factory or the store?
A. About the factory.
Q. 4. Were you present at any time during the last few months when experiments were made in running fats through a coil apparatus, at their factory, to decompose the fat? If so, can you state the dates and under whose charge the operation was conducted?
A. I believe on the 24th of March was the first. I believe it was under charge of Prof. Dudley, chemist expert, and Expert Mechanic Hill and Machinist Manning.
Q. 5. When next were you present at any such experiment?
A. On May 3rd.
Q. 6. Under whose charge?
A. The same gentlemen.
Q. 7. And when next?
A. May 11th.
Q. 8. Under whose charge?

A. The same gentlemen, but there were present two professors—one was named Morton, I think, and the other was a German gentleman. I never heard his name.

Q. 9. Do you know what character of fat was used in those several experiments?

A. Yes, sir.

1373 Q. 10. What was it?

A. It was prime tallow.

Q. 11. In this experiment on the 11th of May, did you know what was done with the material discharged from the coil?

A. Yes, sir.

Q. 12. What was done with it?

A. It was run into five different barrels.

Q. 13. Were these barrels marked?

A. Yes, sir; 1, 2, 3, 4, and 5.

Q. 14. Was this marking in the order in which the material was obtained?

A. Yes, sir.

Q. 15. What, if anything, did you do with the contents of these barrels?

A. Well, the day after I put a closed steam coil into each of these barrels—melted the stuff; and when the water and stock had separated we took the fat off the top and left the water in the bottom of the barrel as near as we could get it.

Q. 16. Did you preserve any samples of the fat thus obtained?

A. Preserved all of them.

Q. 17. If so, can you produce samples from each barrel?

A. Yes, sir.

Q. 18. Do so.

(Five samples in tin boxes are produced by the witness.)

Q. 19. Which of these was taken from the first barrel, which from the second, which from the third, which from the fourth, and which from the fifth?

A. They are marked on the box.

Q. 20. From which barrel was the box marked No. 1 taken?

A. From barrel No. 1.

1374 Q. 21. From which barrel was the box marked No. 2 taken?

A. From barrel No. 2.

Q. 22. Answer also as to the others.

A. Sample marked No. 3 was taken from barrel No. 3; sample marked No. 4 was taken from barrel marked No. 4, and sample No. 5 was taken from barrel marked No. 5.

(Offered in evidence and marked respectively "Defendants' Exhibit, Test of May 11th, Coil Apparatus No. 1, No. 2, etc.")

Q. 23. What other samples have you here? Please state, and, as you state, produce them respectively to be marked as exhibits?

A. Here is a box containing a sample of the saponification

through the tanks, the kind of stock we make ordinarily, tallow stock. This is neutralized and panned, ready for pressing.

(The sample referred to is offered in evidence and marked "Defendants' Exhibit, Sample of Procter & Gamble, Saponification.")

The next one is a sample of the Tilghman apparatus of the 3rd of May.

(Offered in evidence and marked "Defendants' Exhibit, Test of May 3rd, Coil Apparatus.")

The next is experiment with Tilghman apparatus, March 24th.

(Offered in evidence and marked "Defendants' Exhibit, Test of March 24th, Coil Apparatus.")

Cross-examination:

1375 X Q. 24. What did you do with the glycerine water that came from the coil apparatus at the time you took these samples?

A. The water — after the separation. The water was left in the barrel, and when I was called on for the product of the coil apparatus I weighed it and poured it all into one barrel; that, I believe, we still have.

X Q. 25. You mixed all the glycerine water together, do I understand you?

A. Yes, sir; from the five barrels. In that test of May 11th there were only five barrels—portions of five barrels.

JOHN M. DONNELLY.

Adjourned to 3 p. m.

Hearing May 25th, 1883.

Afternoon Session.

JOHN A. PENTLAND, called for defendants, being duly sworn, testified as follows:

Examined by Mr. PARKINSON:

Q. 1. State your name, age, residence, and occupation.

A. My name is John A. Pentland; age, 32; reside [at] 199 Western avenue; occupation, receiving clerk for Procter & Gamble.

Q. 2. What, if anything, do you have [to do] with the weighing of the materials at Procter & Gamble's factory?

A. I have everything to do with the weighing of materials. I receive it and weigh it and use it up in the process of manufacturing; that is, all the fats go through my department.

1376 Q. 3. Do you know anything about any test made with the digesters at that factory in July last?

A. I do.

Q. 4. As to the amount of fat acids obtained?

A. I was ordered by the firm of Procter & Gamble to make a test with ten charges of tallow, which I have done; and I have got the

detailed weights here, the amount of raw fat used, and the result of the saponification of the thing.

Q. 5. Who weighed the tallow and the products?

A. I did.

Q. 6. Did you make any memorandum at the time of the weights?

A. Yes, sir.

Q. 7. Have you the original memorandum with you? If so, please, refreshing your memory by reference thereto, state the amount of tallow used and the amount of fat acids obtained.

A. I have. The amount of raw tallow used was 62,960 pounds—the result was 65,036 pounds of saponified tallow; dark tallow, 468; of dirty tallow—that was a portion that I could not distinguish the amount of dirt that was contained in it—153 pounds; tank skimmings, containing glycerine, 365 pounds.

JOHN A. PENTLAND.

No cross-examination.

Hearing continued on May 16th, 1883, at the office of Parkinson & Parkinson, before the Hon. Channing Richards, master. Appearances as before.

HENRY MORTON was called on behalf of the defendants and, being duly sworn, testified as follows:

Examined by Mr. R. H. PARKINSON:

Q. 1. Please state your name, age, residence, and occupation.

1377 A. My name is Henry Morton; I am 46 years of age; I am the president of the Stevens Institute of Technology, in Hoboken, where I now reside.

Q. 2. What experience, if any, have you had in connection with the study and practice of chemistry generally?

A. I have been engaged in the study and practice of chemistry from my boyhood, when I had a laboratory in my father's house, up to the present time, when I have a laboratory in my own house. I studied chemistry during my college course at the University of Pennsylvania, and afterward took a further course in the same institution. Prof. Frazer was the instructor in chemistry in the regular course and in the post-graduate course. I lectured on chemistry in the Episcopal Academy in Philadelphia for a number of years after I graduated from college; also at the Franklin Institute in Philadelphia. I occupied the chair of chemistry and physics at the University of Pennsylvania during one year, when Prof. Frazer, the regular occupant of the chair, was absent in Europe, and after his return the chair was divided and I was appointed professor of chemistry in the same institution, where I continued until I accepted my present appointment at the Stevens Institute. During all this time and since I have taken considerable interest in the matter of chemical manufactures, and have been frequently consulted as to manufacturing processes involving chemical actions, and have examined and

experimented with such processes at the request of various persons interested in them, and since I have been in New York I have been almost constantly engaged, in such leisure time as my duties at the institute gave me, in similar work, examining chemical processes both in the laboratory and in the manufactory. I forgot to mention that for several years I occupied the chair of chemistry in the Philadelphia Dental College.

1378 Q. 3. What experience, if any, have you had in examining patents and patented processes for the purpose of giving your opinion and testimony in the Federal courts in suits involving questions concerning them?

A. For the last ten years I have been very largely engaged in such work, having probably been concerned during that time in considerably more than 100 suits where questions of chemistry and related matters have been involved.

Q. 4. Have you read, and do you understand, the patent of complainant in this suit?

A. I have, and believe that I do.

Q. 5. Have you read, and do you understand, the construction thereof as expressed in the decision of the Supreme Court in this cause?

(Objected to as incompetent; decision reserved.)

A. (Witness consults a pamphlet.) I have read the matter referred to, and think that I understand the same.

Q. 6. In order that there may be no misunderstanding as to the sense in which you use the term Tilghman process in reference thereto in the course of this examination, please state what you understand that process to be, modifying any construction that you would draw from the patent itself by the interpretation put upon it by the court.

A. The process of separating fatty acids from glycerine without injury to the latter by the single and simple process of subjecting the neutral fats whilst in intimate mixture with water to a high degree of heat, under sufficient pressure to prevent the water from being converted into steam without the employment of any alkali or sulphuric acid or other saponifying agent.

1379 Q. 7. In using the expression "without the presence of lime or other saponifying agent," do you mean that you understand the process does not exist where such other agents are present, or that so far as they are present they are foreign to the process, or what do you mean?

A. I mean that where these agents are present they modify the process, and that any process involving these or other agencies constitutes a modification or improvement upon the process not included in that process as invented by the patentee and set forth and claimed in his patent, or included in said patent by the decision of the court.

Q. 8. Have you read the record in this cause as found in the Supreme Court transcript?

A. I have read a large part of it—that is to say, I have run through it and read the testimony of the experts, and such other matter as

appeared to me to be of interest in connection with the chemical questions involved in the suit. Documents of a purely formal legal character, some portions of the correspondence, and much of the testimony of the mechanical experts, I have not yet read. I may also say I have read all the exhibits.

Q. 9. Have you made any experiments with the Tilghman process with reference to determining the effect of the operations involved therein, and, if so, what are they? I use the term Tilghman process in the broad sense given it in your answer, and not as limited to the specific mechanism or degrees of heat or pressure mentioned in the patent.

A. I have made a number of experiments, some of which I will proceed to relate. In the first place, about the 29th or 30th of March—I have omitted to bring with me a record of the exact date—I made an experiment at my own laboratory, connected with my house in Hoboken, in which I used a vessel represented by the sketch which I have just prepared and will put in evidence as an exhibit.

1380 (Offered in evidence and marked "Defendants' Exhibit Drawing of Laboratory Digester.")

This consisted of a strong vessel of iron, A A', lined with lead throughout, having a movable cover held in place by bolts passing through a flange on the upper edge of the vessel. Through the cover of this vessel there were three openings. To the central one was attached a steam-pressure gauge, B; through another passed a close copper tube, C, in which a thermometer could be inserted, thus enabling one to note the temperature of the interior of the vessel and its contents at any time. Through the third opening there passed a rod, which, by means of a crank, D, could be turned from the outside, and to the end of this, inside the vessel, was attached a gear-wheel, E, working with another gear-wheel of smaller size, F, attached to the shaft of a stirrer, G, which was very much like some forms of egg-beaters, consisting of four wire loops, two of them attached near the end of the rod, and two of them a little higher up, so that when the rod was made to rotate rapidly by turning the handle on the outside this beater produced a thorough mixture or emulsion of the contents of the vessel, if these were melted fat and water or any other material capable of being made into an emulsion by beating up. The fact that a thorough mixture and emulsion was produced I tested beforehand by supporting the cover over a glass vessel in which I placed a mixture of melted fat and hot water, and then by inspection saw that, as I have said, a very thorough emulsion was produced. Finding in the use of this apparatus some trouble from the locking of the gear-wheels inside, I modified it by connecting the stirrer directly with the shaft E, passing through the cover, placing a gear-wheel on the outer end of said shaft in place of the crank D, and driving this by a
1381 small electric engine which I operated by aid of a storage electric battery. By this means an equally thorough mixture and emulsion was obtained with less difficulty than before as regards the mechanism, but it required several experiments to get this part of the apparatus running satisfactorily when the high temperature and pressure were

obtained, as there was great liability at that time for the stuffing-box to leak or to offer too great resistance to the rotation of the rod. The entire apparatus, as represented, was supported on an iron tripod and heated by a multiple gas-burner placed beneath. In the experiment made with this apparatus, in which water and neutral fat were heated alone, I employed 500 grammes of tallow, which I had myself prepared from fresh fat, and 1,000 grammes of water, and I heated this mixture for six hours, with constant stirring by means of the apparatus already described, maintaining the temperature and pressure at a pressure of about 90 pounds and corresponding temperature of 165° C., according to my recollection, as I have not noted this in the memorandum I have here with me, though all the details are in my laboratory book at Hoboken. After the expiration of this six hours of heating, as described, the vessel was allowed to cool, and opened and its contents removed, and a portion of the same was taken by Doctor Endemann, who was present throughout this operation, and analyzed by him. This analysis I verified, and the result was 61.82 per cent. of free fat acid—that is, this proportion of the fat acid was liberated. That ends that experiment.

The next experiment which I made in carrying out this Tilghman process was conducted at Cincinnati in the works of Messrs. Procter & Gamble on May 10th and 11th. One of the large tanks or closed vessels used by them in their regular manufacture was employed in this experiment, and was charged with 7,000 pounds of fat, of which I took a sample from the tank, and 3,050 pounds
1382 of water run in hot from the boiler, beginning at 11 o'clock ten minutes by New York time, until 11.25, when the water connection was shut off on the water appearing at a certain gauge, and steam was turned on from the same boilers which had supplied the water, showing on a gauge attached to the tank about 150 pounds pressure, and about the same by the gauge attached directly to the boilers; but these gauges were not in exact agreement, and I therefore speak of both the pressures as approximate. The one on the boiler was higher, but there were, in fact, two gauges on the boilers, which were themselves different. I have no doubt that the exact status of these gauges will be put in evidence by competent testimony further on. I did not attempt in any way to verify them.

There was an apparatus connected with this tank, essentially represented in this drawing, just taken from the appellant's brief in the Supreme Court, which I do for convenience (marked as "Defendants' Exhibit Drawing taken from Appellants Brief in the Supreme Court"), for causing the circulation and admixture of the contents of this vessel, and this was started in operation as soon as the steam was turned on, and continued in operation during the entire series of experiments, with no other than, I believe, one momentary interruption, when the engine operating this and other mechanism was stopped for a minute or two. The heat and admixture, as above indicated, was continued until about 5.30 a. m. on the 11th of May; but about nine hours from the start I drew a sample of the contents, which I subsequently tested with Dr. Endemann in the laboratory

connected with the medical college in Cincinnati, and found it contained 76.47 of free acids. Another sample was taken at the end of eighteen hours by Dr. Endemann, which I also analyzed with
1383 him at the same time and place with the other, and found it to contain 84.43 per cent. of free fatty acids. I recorded the pressures and watched the operations of this apparatus from the time it was started, as stated above—*i. e.*, 11.10 a. m. until 11 o'clock the same night, when Dr. Endemann came by appointment and relieved me. During all this time the pressure on the gauge attached to the apparatus was about 150 pounds, but varied from time to time, thus:

At	11.50	a. m.	it was	140	pounds.
"	1.03	p. m.	"	145	"
"	2.35	"	"	152½	"
"	3.07	"	"	152	"
"	3.30	"	"	155	"
"	4.10	"	"	155	"
"	4.55	"	"	156	"
"	5.53	"	"	152	"
"	6.15	"	"	149	"
"	7.05	"	"	150	"
"	8.00	"	"	155	"
"	9.00	"	"	147	"
"	10.00	"	"	146	"
"	11.00	"	"	147	"

About 7 o'clock the packing of the gland through which the pump-rod passed began to leak, causing a slight escape of steam for a moment at the end of each up stroke. This was caused by a roughness on the pump-rod, which cut and displaced the packing, and also by the fact that this rod naturally was a little smaller at its lower than its upper part. By screwing up the gland, this was remedied from time to time, and was never of any serious account while I watched the apparatus.

I also witnessed and assisted at another experiment with the Tilghman process. In this case an apparatus was employed
1384 which, as I understand, was a careful reproduction of a proposed plant, fully described in some early part of the testimony in this case, but about its exact construction I am not able to testify, having simply looked at it from the outside, and can only say that it was a large size apparatus, occupying a considerable space—I should presume a cubic space of 40 feet by 20 by 12 for the entire apparatus, and capable of operating upon about 150 pounds of fat per hour. The coil, which was, as far as I could see, exactly such a coil as is shown in the drawing accompanying the Tilghman patent, figure 1, was heated early in the day, and water kept running through, under a heavy pressure, as indicated by a pressure-gauge close to the final outlet, and at 3.13 in the afternoon of May 11th an emulsion of fat and water, in the proportion indicated in the Tilghman patent, was started into the inlet end of said coil. This emulsion appeared at the outlet of the apparatus—that is, be-

yond the cooler—at 3.26, which allowed ten minutes for the passage of the mixture through the heated coil, and three minutes for its passage through the cooler. These, as I understood from the engineer, Mr. Hill, who had the matter in charge, would represent about the relative capacities of the heated coil and of the connecting pipes and cooler, so that this observation showed that the emulsion occupied about ten minutes in passing through the heated coil. Observations were made by others in charge of the apparatus as to the rate of flow by collecting the emulsion as it came from the outlet and weighing it, and these, as I understand, indicated the same rate of flow. The first sample of the emulsion I took myself at 3.27, at which time a portion of tin inserted into a cavity in the iron casting of the coil was melted. The pressure at the outlet, as indicated by the gauge, showed 2,100 pounds, and the sample then taken, afterward analyzed by me with Dr. Endemann at the medical college, showed 52.8 per cent. of free acid. I give below
1385 a tabulated statement of the results of those observations and analyses:

No.	Time.	Press.—pounds.	Temp. at coil.	Temp. at outlet—degrees F.	Free acid.
1	3.27	2,100	Tin melted		52.8
2	3.32	2,000	Bismuth softened	178	
3	3.37	1,600	" melted	188	55.5
4	3.42	1,400		191	
5	3.47	1,950		162	
6	3.57	2,000	Only tin melted	162	51.8
7	4.01	1,650		165	
8	4.26	2,000	Lead melted	168	81.25
9	4.35	1,900	" "	179	
10	4.45	1,400	" "	149	78
11	4.55	2,100	" "	118	79.1

About the time the last sample was taken a quantity of smoke and pungent vapor filled the building, coming, as I was informed, from a fracture of the exit-pipe from the heated coil. In consequnce of this the experiments had to be discontinued. During these experiments, from time to time, I observed the odor of the product as it came from the outlet, and, while at first there was a very slight smell of acroleine, this increased and became very pronounced when the lead was melted in the cavity upon the heated coil. The emulsion flowed in a smooth, regular stream almost throughout. Just at the start there was a momentary obstruction and rush of the emulsion, but this was not repeated, as far as my observation went, although there was a little variation in the rate of flow, due, as I

believe, to small irregularities in the working of the pump, which were, no doubt, also the cause of the variations in pressure. I think that covers the ground.

Q. 10. State whether or not, preparatory to and in connection with the experiments of which you have spoken, you made
1386 any special study of such authorities bearing upon this and analogous subjects as might aid in qualifying you to make thorough and fair experiments, whether or not the experiments were made with endeavor to obtain as favorable results as were practicable by the process referred to, and whether, in your opinion, they were sufficient to qualify you to form a reliable opinion as to the practical results to be obtained by such process.

A. I had been familiar with the general literature of this subject for many years prior to the time when I was asked to give special attention to the same in connection with the present case, and, since then, I have further refreshed my knowledge by reference to such authors as I considered would give me information, as well as by reading the record and exhibits in this case already referred to. I have also made a number of experiments under processes having relation to this, and in these and in the experiments which I have just described I have taken every precaution I knew of to secure a good and fair result, my desire being to be accurately and correctly informed as to what were the facts, and it is my belief that these experiments have been sufficiently extended to enable me to form a correct judgment.

Q. 11. Referring now specifically to Exhibit No. 4, page 247 of the transcript of the Supreme Court record, and Exhibit No. 10, page 251, please state whether or not you understand the same, whether or not you have made any experiments that would enable you to determine the effect of the process therein referred to. If so, describe the experiments.

A. I have read the descriptions to which you refer, and believe that I fully understand them, and have made experiments with a view of testing the accuracy of the statements contained in these authorities.

In order to make these experiments I caused to be constructed an apparatus, of which the drawing now marked "Def't's Ex-
1387 hibit Distilling Apparatus" (so marked) is a sketch. This consisted of an interior copper vessel, AA′, surrounded by an exterior copper vessel, BB′, the space between, up to about the line CC′, being filled, in my experiments, with the substance, crude anthracene, one of the coal-tar distillation products, which has a very high melting and boiling point, and served as a bath to regulate the temperature. Through the covers of both the exterior and interior vessels, and attached to the cover of the interior one, passed a vertical pipe, DD′, which descended to the bottom of the vessel, and was there expanded, leaving a narrow outlet around its outer edge. Into this vertical tube there entered a small pipe, EE′, by which superheated steam could be passed, and from the upper end of the same pipe was lowered a thermometer, held in place by a cork closing the upper end of the said pipe. This thermometer was therefore im-

mersed in the entering superheated steam. From the side of the interior vessel passed out another large copper pipe, FF′, which was connected to a condenser, consisting, in this case, of a large glass flask, into which the vapors passed directly, and from which they then passed into a straight tube condenser known as a Liebig condenser A thermometer, GG′, passed through the cover of the outer vessel, and dipped into the anthracene. In using this apparatus I placed in it 60 grammes of tallow, and then applied heat to the outside of the exterior vessel until the thermometer introduced into the anthracene showed a temperature a little above 280 degrees centigrade or 536 Fahrenheit. I then started steam from a small boiler through a superheating apparatus, which consisted, in fact, of a combustion furnace, such as used in organic analyses, and, when this was operating smoothly, connected the outlet from this superheater with the tube EE′, so as to allow the superheated steam to enter the vertical tube DD′ and escape through the melted fat. By adjusting
1388 the combustion furnace or superheater I kept the temperature of the incoming steam at 280 degrees centigrade or 536 degrees F., very steadily, with only slight fluctuations, and in a very short time I found an oily and watery fluid collecting in the condenser. At the end of about two hours I discontinued the process, and collected the water and the oily matter. The oil solidified on cooling, though part of it was formed into an emulsion with the water, which required to be warmed in order to melt it together and obtain it as a fat. The entire product of fatty matter was fused together and then tested, and found to consist of an essentially pure fatty acid—that is to say, it showed fully 99 per cent. of free fat acid. The watery liquid was evaporated and yielded a corresponding quantity of glycerine. There was never, in the experiment to which I have referred, any smell of acroleine—the glycerine tasted sweet and pure, and the fatty acid was light colored. There was certainly no decomposition produced by heat alone, but a saponification, pure and simple, effected by the steam upon the fat, and this was thoroughly complete. The oil or fat used showed less than one per cent. of fat acid, free acid, before use, while that which remained in the still, as I may call it, showed, as I recollect, about 3 per cent. of free fatty acid, proving that a portion of the fat had been decomposed by the action of the steam before it was distilled over. On first setting up this apparatus the boiler used to produce steam was placed at a higher level than the superheater, and, in consequence of this, soon after starting, some drops of water condensed in the pipe connecting the boiler with the superheater, and these being from time to time suddenly thrown into the superheater produced an almost almost explosive rush of vapor into the apparatus. This, in the first place, broke two thermometers, and prevented me from being able to regulate the temperature, and besides drove the steam through the apparatus at moments with such violence that fatty mat-
1389 ter would undoubtedly be mechanically carried over. I therefore discontinued the experiment, and, in the subsequent operation, which is the one I have described, simply placed the boiler at a lower level than the superheater by an inch or so,

whereupon no further difficulty was experienced, and the operation was conducted with perfect smoothness and a continuous good result. That, I think, finished that experiment. I have not a complete memorandum, and I do not recollect the amount of fat acid obtained or the amount of glycerine.

By Mr CHAMBERS:

Q. 12. Are you able to state the amount of the residue?

A. I have not got it down. Dr. Endemann and I were working together, and therefore I did not make a complete memorandum. I think one of us has it, or that I have it in my laboratory book. I had this small book which I have here in my pocket and noted some things in it, but not everything. I cannot be positive as to whether I have the amount of glycerine noted in my laboratory book. The amounts were small, and I do not know whether I weighed the quantity or not. These quantities and weights were, of course, determined subsequently to the time of making the experiment, as the water containing the glycerine had to be evaporated and the fatty acids collected and melted.

By Mr. PARKINSON:

Q. 13. State whether or not, in your opinion, the exhibits referred to in the last question sufficiently exhibit this process and the method of operating it to enable one skilled in the art, as it appears in publications prior to that date, to carry on the operation with the results you obtained.

1390 A. I think that the description here given is abundantly sufficient. I myself did nothing but literally follow it, and if any additional knowledge to that contained in this extract were required it would simply be the fact, well known at that time, that fats, when decomposed in the presence of water, yielded fat acids and glycerine, and that, if no acroleine was formed, the glycerine produced must be found in the product, and could be recovered from it by the simple evaporation of the water.

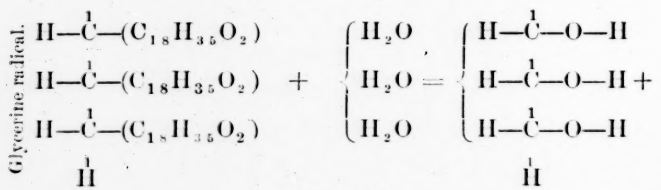
Q. 14. What is the reaction that takes place in this process?

A. The steam combines in part with the fat acid and in part with the radical of the glycerine, producing by those combinations fat acid and glycerine. In other words, the fat is a compound, or rather, I should say, is a mixture of several compounds of closely analogous constitution known as stearine, palmatine, and oleine. Confining our attention to one of them, for example, stearine—this is a compound of three molecules of what may be called the radical of stearic acid, or stearic acid minus one atom of hydrogen, whose chemical formula would be $C_{18}H_{35}O_2$, combined with one molecule of the radical of glycerine, whose formula is C_3H_5, which differs from glycerine by three atoms of hydrogen and three atoms of oxygen. Now, when steam at a sufficient temperature is brought into contact with such a fat, it gives to each of the three molecules of the acid radical one equivalent of hydrogen, and to the corresponding molecule of glycerine radical three atoms of ogygen and three of hydrogen, thus converting the first into three molecules of fatty acid and the last

into one molecule of glycerine. For this, three molecules of water are needed, each molecule being expressed as H_2O.

1391 Stearine. Water. Glycerine.

H stearic acid radical. H



Stearic acid.

$3(C_{18}H_{36}O_2)$

Recess until 3 p. m.

WEDNESDAY P. M., *May 16th*, 1883.

Examination of HENRY MORTON continued.

By R. H. PARKINSON:

Q. 15. In the process last referred to what are the agents which affect the decomposition of the fat?

A. Heat and water in the form of steam.

Q. 16. Give your reason for the thoroughness of the decomposition that is obtained.

A. As fast as the fatty acid and glycerine are developed or formed they are removed, being carried out of the heated vessel by the current of steam, and therefore, fresh steam entering, acts upon relatively pure fat with no detrimental effect from any products of previous reaction. It is for this reason that I think that so complete a decomposition can be effected.

Q. 17. What, if any, difference is there between the reaction effected by steam and that effected by water when the temperature is the same?

1392 A. Provided that the temperature is high enough in both cases to effect a change, the nature of the reaction is identical and would be represented chemically by exactly the same chemical formula.

Q. 18. Referring to the extract from Roret's Encyclopedia, on page 474 of the record, and to the DeMilly & Motard patent there referred to, state whether or not you understand the same and whether or not you have made any experiments which would determine the practical effect of the process therein indicated.

A. In the passage referred to I find the following statement: "It was believed for a long time that saponification by lime could only be effected in closed boilers, and, although it has been since ascertained that increased pressure and consequently increased temperature are not indispensable for this saponification, it is quite possible that, returning to the former opinion, we may effect an important

diminution in the proportion of lime required for a given weight of fat."

This seems to me to be a perfectly clear and unambiguous suggestion that by the use of pressure in an inclosed vessel a smaller amount of lime than that which experience or calculation indicated could be used by reason of some additional efficiency secured by means of the heat and pressure.

The next question, then, in reading this article, would be, what arrangement might have been at that time suggested for accomplishing these results, and this I find fully stated in the Demilly & Motard patent, from which a passage is quoted in this same extract, as follows: "The boiler employed by the inventors is of a cylindrical form, its upper part terminating in a man-hole hermetically closed by a bolted cover. This cover has in its center a stuffing box, through which passes a stirring rod, with a cross-piece of wood on its lower end. Another hole in the cover is for a tube which plunges some six inches into the boiler and which is to contain a thermometer. The boiler is heated by a furnace of usual construction.

1393 Water is first run into the boiler equal about to twice the weight of fat to be saponified. The fat is then introduced, and when it is melted milk of lime sufficient for the saponification of the fat is run over the liquid mass. The boiler is then closed, and the liquid stirred at short intervals by raising and lowering the stirring rod or plunger. This operation is continued until the thermometer marks 277 degrees Fahrenheit or 136 degrees centigrade. As the whole mass becomes stiff after a certain time, agitation is no longer practicable, and the operation is left to itself, and ceases with the diminution of the temperature. When the thermometer only shows 212 degrees Fahrenheit the boiler is opened and emptied by the man-hole as soon as it is sufficiently cooled."

This description of apparatus and process, as it seems to me, would fully inform any one, even if not specially skilled in this art, that a closed boiler capable of sustaining considerable pressure was to be used; that some efficient means of agitation was to be employed, and that using this it would be possible to obtain complete saponification or separation of the fat into acid and glycerine by the use of a less quantity of lime than had been before used. An intelligent operator, then, with this description before him, would construct some such apparatus, or would take advantage of one or other of the many forms of apparatus meeting these conditions then known, and would put in the fat and water as directed and add so much lime as he thought would be sufficient under these new conditions to effect the saponification.

Unquestionably experiment would have to be tried to find how little lime could be used, and the probabilities are that the intelligent operator would begin with a moderate reduction in the amount, and, finding a successful result, would continue to further reduce until he reached a point at which he could no longer obtain a well-saponified product.

1394 Having this idea as to the bearing of this exhibit, I made, in the first place, an experiment with the same apparatus

which I used in carrying out the Tilghman process in my own laboratory, as I have above related. For this purpose I placed in the apparatus 500 grammes of pure tallow, prepared by myself, 1,000 grammes of water, and 5 grammes of lime, and I heated this with continual stirring by means of the apparatus already described for six hours, at the end of which time I allowed the apparatus to cool and removed the contents, treated the same with sulphuric acid and water, and separated out the lime and handed a portion to Dr. Endemann. His analysis of that sample showed 84 per cent. of free fatty acid in the product.

By the MASTER:

Q. 19. That is the percentage of the product in all cases?

A. Yes, sir; in all cases. Eighty-four per cent. of the product in this case was free fatty acid; the pressure throughout was 90 pounds, and the corresponding temperature 165 degrees centigrade, as I recollect.

I made another experiment in the same direction at the same time with the experiment which I have already related, as carried out at the works of Messrs. Procter & Gamble, on May 10th. At the same time that one tank was filled with the mixture of fat and water, about which I have already testified, another precisely similar tank was filled with the same amount of fat and a little larger quantity of water in consequence of a difference in the adjustment of the gauges. The quantity of water in that case was 3,850 pounds. To this were added 70 pounds of dry lime previously slaked. This was heated to the same temperature and pressure exactly as the
1395 other cylinder for nine hours. In fact, the steam-pipe which supplied the two cylinders branched and opened into both of them, and a pumping apparatus precisely like that used in the other cylinder was kept in continual motion, which served to mix the fat and water. At the end of nine hours from the time of starting I took from this tank a specimen of the oily product, which I have analyzed with Dr. Endemann at the medical college at the same time with the other samples, and found that it contained 88.85 per cent. of free fat acids.

Q. 20. At the date of this Roret publication, was or was not the knowledge accessible in publications recognized in this science that heated water would effect the separation of the neutral fat into the acids and glycerine?

(Objected to by counsel for plaintiff as incompetent.)

A. At the date of this publication, which, I believe, is 1853, it was known that water in the condition of steam would effect this decomposition.

Q. 21. Can you conveniently refer to any authority showing that it was known prior to the date of Roret that heat and water, without the aid of lime, would effect the separation of fats into fat acids and glycerine?

(Objected to by counsel for plaintiff as incompetent, so far as this

question and the line of examination, of which it forms a part, goes to the interpretation of the meaning of publications and exhibits passed upon by the Supreme Court, and to the novelty of the complainant's patented invention.)

The MASTER: The master rules that the question may be
1396 put. As to the other question, I don't think I can pass upon it until it comes up in some practical form.

(To which ruling counsel for plaintiff excepted.)

A. The fact that heat and water, in the form of steam, would effect such a separation is, I think, stated in the patent of Dubrunfat, in 1841, and in the article by Prof. Scharling, in the Journal of Practical Chemistry, published at Leipsic in 1850, these being respective Exhibits 4 and 10 in the article.

Q. 22. What are the relative advantages and disadvantages of using heated water under pressure, as compared with free steam at the same temperature, and were these advantages and disadvantages familiar to chemists at the date of this Roret publication? And please give your reasons for your answer.

A. The advantage in using water under pressure would be the concentration into relatively small space and the increase in the solvent power of the water for any soluble material that might be present, and which it would be easier to bring into contact with other materials when it was in a state of solution. The relative advantage of the use of free steam would be the purity of the fatty acid obtained and the freedom from the risks and difficulties attending the use of water under high pressure combined with heat. I think that at the date referred to both of these or all of these conditions of relative advantage were well understood. The digester of Papin, which had been invented very long before, had been used extensively, and its efficiency in increasing the solvent power of water was well known, and it was manifest that it would accomplish a great concentration of action as compared with the operations of free steam. A sufficient decription of Papin's digester is found in
Exhibit 11, page 254 of the record, though, of course, numer-
1397 ous references might be given in other works. The exhibits to which I have just referred, 4 and 10, I think fully exhibit the advantages of the steam process in effecting a perfect decomposition and yielding a pure product; and it was, of course, matter of common knowledge that in free steam there was no danger such as existed with water at a high temperature under pressure.

Q. 23. Have you read the description of the defendants' process found in the answer in the transcript of the Supreme Court record, and do you understand the same?

A. I have read it and believe that I understand it.

Q. 24. Please state what, if any, differences you find between that and the Tilghman process, as heretofore referred to.

A. I find two items of difference. In the first place, in the defendants' process, I find that one per cent. of lime is used; that is, one per cent. of the weight of the fat, and also I find that, after

the water, fat, and lime have been heated for a certain time, the water containing glycerine is withdrawn and a quantity of fresh water is introduced.

Q. 25. Do either or all of the differences mentioned by you have any effect upon the efficiency and utility of the process? If so, what kind of effect? Please state fully.

A. The addition of lime has, in my opinion, a very important effect. In the first place, it must be remembered that each per cent. of lime, if it thoroughly reacts, as it undoubtedly does, under this condition of increased temperature and pressure, decomposes about eleven per cent. of fat, developing a corresponding amount of fat acid in the final result. In addition to this, it is, chemically, extremely probable, and in entire accordance with all chemical analogies, that, under such conditions, the lime should form an acid salt. It is quite true that no such acid salt of lime has as
1398 yet been recognized by chemists, as far as I am aware. But the reasons of this failure to recognize it are very manifest, and do not in any way touch the probabilities of its existence. Precisely analogous acid salts, or acid soaps, are formed with soda and potash, and have been recognized for a very long time. I have not attempted to determine the earliest dates at which these are mentioned, but all ordinary books on chemistry describe them. Thus, in the text-book which is more widely used, I imagine, than any other in the colleges of the country, namely, that by Prof. Fownes, of which I happen to have a copy, published in 1868, here, on page 734, speaking of the compounds of stearic acid, the author says as follows: "The normal potassium salt, $C_{18}H_{35}O_2K.$, separates, on cooling, from a solution of one part stearic acid and one part potassium hydrate in ten parts of water, in white, opaque granules. The acid salt, $C_{18}H_{35}O_2K.$, $C_{18}H_{36}O_2$, is obtained by decomposing the normal salt with 1,000 parts or more of water, and separates in silvery scales from the solution in boiling alcohol. Normal sodium stearate, $C_{18}H_{35}O_2Na.$, is very much like the potassium salt, but harder. The acid salt, $C_{18}H_{35}O_2Na.$, $C_{18}H_{36}O_2$, obtained by decomposing the normal salt with 2,000 parts or more of water, separates from the hot solution in nacreous laminæ." The lime salt, being insoluble, manifestly cannot be recognized, even when it exists, by any such means as reveal the presence of the acid salts. I think it would be undoubtedly a very difficult matter to prove its existence, even were it present. Certainly, no demonstration as to its presence or absence could be made by the use of alcohol or other like solvents, since nothing is more familiar to any chemist who considers the subject than the decomposing power of alcohol and these other like solvents. Alcohol, for example, decomposes so strong a salt as the acid sulphate of potash, precipitating the neutral sulphate from solution. It will also decompose the acid phosphate of lime, producing, in the first instance, what is known as the three-fourths
1399 phosphate of Berzelius. In fact alcohol forms with soda and potash and many other bases well-recognized salts known as ethylates, and nothing is better recognized at the present time, certainly in chemical analysis, than the fallacy of any method of

separating mixtures by reason of solvents, on the assumption that the solvent will act upon one and not upon both the substances present, even when, as a matter of fact, it will dissolve one and fail entirely to dissolve the other, when they are not both present at the same time. In this particular connection it is well known that when alcohol has dissolved a small amount even of fatty acid it acquires a great solvent power for neutral fat, and the mixture of neutral fat and fatty acid treated with alcohol will be dissolved, in many cases, just as though the whole were fatty acid. As bearing upon the formation of an acid salt of lime, we know that other acids, members of the fatty acid series, such as acetic acid, do form readily acid salts with lime, and it is safe to say that the chances are probably a hundred to one that with proper precautions an acid lime salt of fatty acids or an acid lime soap is made when the requisite materials are brought together under such conditions of heat and pressure as exist in the process of defendants. Of course until such a compound has been proved positively to exist we cannot assert with certainty that it is there present; but the probabilities of its presence on chemical grounds are exceedingly strong. Considering, in the next place, the effect of the change of the water in this process, the experiment which I tried and discarded in the outset of the experiments which I have made at Hoboken, and in which, through an accident, the was changed, indicated most clearly that by this change a far better saponification was obtained than where everything else was identical, with this exception. Another experiment made at my request by Messrs. Procter & Gamble developed the same thing—
1400 that is, two products obtained under identical conditions, except that in one the water was changed and in the other it was not, showed a very marked increase in the yield of free fatty acid where this change of water was made. Thus, a product heated for nine hours with one per cent. of lime and a change in the water showed 97.5 per cent. of free fatty acid, the pressure being 150 pounds pounds with the usual quantity of water—that is, about 3,000 pounds to 7,000 of fat, whereas the same amount of material heated for the same time under the same pressure, without change of water, gave 88.85 per cent. of free fatty acid, as I have already described. Where the water was changed the total amount of water used was twice as great as where the water was not changed.

Morning Session.

THURSDAY, *May 17th*, 1883.

Examination of Prof. HENRY MORTON resumed.

By R. H. PARKINSON:

Q. 26. What would be the effect of substituting 6,000 pounds of water for the 3,000 pounds, where you are using 7,000 pounds of fat —the 6,000 pounds of water being put in all at one time, instead of in portions successively?

A. As regards the final result, I don't think there would be any notable difference, as I have not noticed any that was at all marked

where the experiments have been made with different portions of water, provided that in all cases we use a sufficient amount of water, as, for instance, 50 per cent. of the weight of the fat to begin
1401 with. Of course the use of a larger amount of water has the effect of diluting the glycerine solution obtained, and also requires a more bulky apparatus to carry on the process where it is all used at once, and would therefore, in this regard, be undesirable.

Q. 27. To avoid any possible misconception of your answer, please state whether, when you say you do not think there would be any notable difference, you refer to a comparison between the use of 3,000 and 6,000 pounds of water or to a comparison between the use of the 6,000 pounds altogether and the use of it in successive installments.

A. I refer solely to the comparison between 3,000 and 6,000 pounds of water added in each case at once.

Q. 28. Have you examined such evidence as you could find in the record relating to experiments made with the Tilghman process with the purpose of ascertaining whether or not you find in that evidence anything that proves to you as a chemist that substantially thorough saponification was obtained and free fat acid yielded in substantial purity; if so, do you find anything showing that result to have been obtained in any of these experiments?

A. I have not been able to find in the record anything that proves to me as a chemist that in any of the experiments made and recorded in that record where the Tilghman process, as I have already defined it—that is, where water, heat, and pressure, were the sole agents of saponification—was used, that such process yielded a substantially saponified product, or, in other words, a product consisting substantially of free fatty acids and glycerine without a large percentage of neutral fat. In many of the experiments related the witnesses have confined themselves to stating that they obtained by that process glycerine and free fatty acid, leaving it quite indefinite whether they did or did not also obtain any amount of undecomposed fat. But in some cases it is stated specifically that the
1402 product was substantially glycerine and free fatty acid, this conclusion being founded upon the fact that the fatty portion of said product was completely soluble in alcohol. As the best and most complete statement, I would refer to the testimony of Prof. Booth, on page 611, where he speaks as follows: "The fatty matter which came through the apparatus was tested by hot alcohol and found to dissolve entirely, and on cooling the solution very little unaltered fat separated from it; I estimated not one per cent." After what I have already said about the unreliability of this test with alcohol in the case of a mixture of fatty acids and neutral fats, it is hardly necessary to say that this test, so far from showing that the material was substantially a pure fatty acid mixture, would to me be conclusive that it contained a large percentage of neutral fat, since, if about one per cent. separated from the solution on cooling, I should consider it very certain that 10 per cent. or more remained in the solution of fat acid in alcohol, which is a well-known solvent for neutral fat. In another experiment described by Prof. Booth on

page 613, where the mixture of fat and water was heated for forty minutes to a temperature close to that of melted lead, nothing whatever is said as to the purity of the product. On page 614 Prof. Booth states, in answer to question 152, that he rendered and treated with pressure a portion of the product obtained from the coil apparatus, referred to already as part of my present answer. And in answer to the next question he states that he compared the solid acid obtained by such rendering and pressure treatment with recognized commercial samples of fat acid. But this, of course, proves nothing, except that there was some notable amount of fat acid of the more solid kind, such as stearic acid, in the product—since the treatment by pressure would have removed all the undecomposed fat that might be present, and would leave a good stearic acid, provided the amount of neutral fat left by the saponifying treat-
1403 ment were not in great excess, say 40 or 50 per cent. A careful study of the references to this subject which I have found in the record leaves in my mind the conviction that this is an unsettled question as far as the evidence so far adduced is concerned, and, as my experiments have invariably shown me that a thorough saponification cannot be produced under any conditions that I could secure by the use of heat, water, and pressure alone, I feel confident that the opposite impression produced in the minds of these witnesses by their experiments comes simply from the fact that they had not at their command and did not use such reliable methods of analysis of mixtures containing fat acids and undecomposed fats as have been recently introduced and were employed by me in testing the samples of product which I obtained.

Q. 29. Please state what method of analysis you use upon the product you obtained as referred to in your last answer, stating also whether or not these are in your profession regarded as reliable methods of analysis.

A. The method I employed was one which has been published, I think, within the last year in one of the standard German chemical journals. But I have not made a memorandum of the name or page, but can readily supply it, and will do so. The method is as follows: I prepared, in the first instance, what is known technically as a normal solution of sulphuric acid, adjusted to contain in each litre, or thousand cubic centimetres, 49 grammes of mono-hydrate sulphuric acid. I then prepared an alcoholic alkaline solution, which, by comparison, I found to contain such a proportion of alkali that one cubic centimetre of the acid solution would neutralize exactly 1.21 cubic centimeters of the alkali solution, when the two were mixed in 150 cubic centimeters of the 95 per cent. alcohol I was using for the tests. This being arranged, I weighed out 5
1404 grammes of the fatty substance to be examined and dissolved it with hot alcohol, using 150 cubic centimeters of alcohol for that purpose. I then added to this solution a few drops of the alcoholic solution of phenol-phthalein, which is employed as an indicator—that is, it changes to a bright pink or red color the moment the slightest excess of alkali is present, but becomes colorless as soon as this is neutralized by any acid. Matters being so arranged, I dropped

in rapidly, but carefully, from a graduated burette the alkaline solution above referred to, while constantly stirring the alcoholic solution until a pink color showed itself. I then immediately stopped and measured off or noted the amount of alkaline solution which had been used out of the burette. This amount of alkali used indicates the amount of free fatty acids present in the solution, but says nothing as to the undecomposed fat. To determine this an additional amount of the alkaline solution is added from the same burette, careful note being taken of the quantity; and the vessel containing the solution is then placed on a water-bath and heated for about a half hour to a temperature which makes the alcohol boil gently. The vessel being covered with a watch-glass the alcohol vapors condense, and there is little or no loss of this material, which is immaterial anyhow. Then this treatment having, as we know, completely saponified any neutral fat which existed in the original solution, we bring the vessel under a similar burette containing the normal acid solution and drop this solution into it with constant shaking until the color is destroyed. We then know that whatever excess of alkali was not used up in saponifying the remaining neutral fat has been neutralized by the acid we have added, and the difference between the portion of alkali corresponding to this added acid and the additional alkali that we added after the first test represents the amount of alkali required to saponify the neutral fat, or, what is the
1405 same thing, to neutralize the acid of said neutral fat present in the solution. We, therefore, can by a simple proportion determine from the amount of alkali needed to neutralize the free fatty acid and the amount needed to neutralize the acid in the neutral fat what was the proportion of each of these in the mixture. Suppose, for a simple numerical illustration, that 90 measures of alkali had been used to neutralize the free fatty acid, and that ten more were required to neutralize the acid in the undecomposed fat; we should then know that 90 per cent. of the fatty mixture was free fatty acid, and 10 per cent. was undecomposed fat. Of course in this calculation I neglect the minute correction for the glycerine present in the undecomposed fat, but in these determinations it is generally so small as not to be worth accounting, but, of course, is easily estimated or introduced by a correction if we desire to do so.

Q. 30. Referring now to the process of saponification recited in defendants' answer as that used by defendants, can you state about what is the efficiency in their process of the one per cent. of lime mentioned as there used, giving your reasons for any opinion you may express?

A. From the experiments which I have made myself, and others which I find in the record, or which have been made at my request, I am of the opinion that this one per cent. of lime practically effects a gain of about twenty per cent. in the amount of free fat acid obtained as a final result in this manufacture—that is, I include in this the fat acid obtained from the lime soap as well as the acid free at the moment the material is taken from the tank. As this draws my attention to it I might state here that wherever I have spoken of the free fat acid in these products where lime was used I include

that portion of acid which was combined with the lime and was separated by the subsequent treatment with sulphuric acid.

1406 The fat acids produced by these processes are always subjected, as a matter of course, to the treatment with sulphuric acid to clarify them, and, therefore, it did not occur to me to specifically state this before. This is the actual numerical difference which appears to result from the treatments (otherwise identical) with and without lime. Besides this, however, there is another view of the efficiency of the lime in this relation. It would also appear from my own and all the other experiments with which I am acquainted that the production of a practically thorough saponification without lime or some other equivalent material, or in other words by the action of water, heat, and pressure alone, cannot be obtained and never has been obtained either on the laboratory or commercial scale. And therefore the efficiency of the lime in securing this result may amount to much more than an increase of 20 per cent. in the total amount of free fatty acid obtained from the process, for it is manifest that 20 per cent. or even less of undecomposed fats left in the mixture will act very disastrously upon the subsequent steps in the treatment. Thus, for example, a mixture of the fats, such as tallow, contain notable amounts of oleine which is the more difficult substance to saponify and is consequently the last acted upon. This therefore remains to a large extent unsaponified and in the subsequent operations of pressing is likely to carry away into solution a large proportion of the stearic acid which is formed.

Q. 31. Can you give any further explanation of the large efficiency of this per cent. of lime, or of the reasons why so small a per cent., comparatively, of free fatty acid is obtained where lime is omitted as compared with the process where it is present?

A. The explanation of this curious result is, of course theoretical, but it seems to me highly probable that the neutral lime soap, which undoubtedly would be formed during the process, may act as

1407 a carrier between the water and the fat in the sense of passing into an acid condition where it is in contact with excess of fat, and being reduced again to a neutral state in contact with excess of water. It may be that its action is connected with the observation which has been made recently by a German investigator, that neutral fats consist of minute globules of fatty matter inclosed in albuminous envelopes, and that the lime may assist in attacking this covering just as the sulphuric acid does, and in a manner analogous to that in which certain oxidizing agents act upon certain vegetable oils, rendering them drying, by the removal of some similar material which prevents their drying otherwise. This, however, is simply a suggestion, and my own conviction is that it is rather a direct action of the lime soap, at one time acting upon the fat, where that is present to it in excess, and then again reacting with the water, and so serving, as I have said, as a carrier to effect this change.

Q. 32. What is the equivalent of lime from a 100 pounds of fat?

A. About nine and a half pounds of dry lime. That is the chemical equivalent.

Q. 33. What is the highest possible yield of fat acid from a 100

pounds of neutral fat of the character commonly used for saponification, assuming the fat to be of first quality?

A. About 95.5 per cent. In other words, the theoretical maximum, or the actual amount of fat acid producible from a pure mixture of the fat, if the saponification were absolutely perfect, would be about 95.5 per cent. Pure stearine would yield in this sense 95.7 per cent., pure palmatine would yield 95.2 per cent., and pure oleine would yield 95.7. The ordinary fats being mixtures of these in somewhat varying proportions, the theoretical maximum yield must be between the limits of 95.2 and 95.7 per cent., assuming that we start with thoroughly dried fat, and make no allowance for the
1408 minute quantities of volatile compounds present in these. In practice I should suppose that at least one per cent. ought to be allowed for inevitable losses and for the fact that fat as weighed would always contain some water.

Q. 34. Suppose 100 pounds of neutral fat, 14 pounds of lime, 50 pounds of water, at 277 degrees Fahrenheit, placed in a tank together, what would take place? Please describe fully.

A. The rapidity of the actions would depend, of course, to a certain degree, upon the fact of agitation or rest. But whether the materials were mixed or not these general actions would undoubtedly take place: The water at that temperature—and I, of course, assume the corresponding pressure—would attack the fat directly. It would also dissolve a portion of the lime, and this solution of lime would likewise attack the fat, forming a lime soap, and these actions would go on together continuously, with any others such as I have before alluded to as possible between the lime soap and the fat and the water on either hand, until, as a final result of all with the quantities mentioned, the entire fat was resolved into a mixture of lime soap and glycerine, the glycerine, of course, being dissolved in the water. But a portion of this lime soap would unquestionably be formed by the union of fatty acid liberated by the direct action of the water with the lime, as there certainly would be nothing which would prevent the water from having this action during the time that the operation was going on prior to its completion. The less perfect the mingling of all the materials the slower would the action be and the more time would there be for these divers chemical actions—that is, the action of the water as such on the fat at certain points; or, in other words, the reaction of certain molecules of water with certain molecules of fat while other molecules of fat were reacting with the wet lime in contact with it, or with portions of
1409 the water saturated with lime. The only condition of things under which we could conceive of any other than such a various action would be an absolutely molecular mixture. In other words, that each molecule of each substance was, at the first instance, put in contact with another molecule of each of the other substances. Of course such a condition of things is utterly beyond any practical attainment, and is, in fact, hardly conceivable.

Q. 35. Suppose the other conditions remaining the same as in the last question, you place instead of 14 pounds of lime nine and a half pounds, what operation would take place?

A. The general character of the reactions would be the same, except that more opportunity would be given for the water to act directly in attacking the fat and saponifying it. The lime, on its part, of course, would likewise attack the fat, and after a certain time would form lime soap with as much of it as it would hold.

Q. 36. What would be the character of the operation, the other conditions remaining the same, if you substituted for the amount of lime above named one pound of lime?

A. The only difference would be that in the same time less fat would be saponified by reason of the less amount of lime aiding in the operation.

Q. 37. Does it make any difference in the process of saponification whether the water is gradually heated after being brought in contact with the fat or whether it is introduced already heated to a high temperature? I refer to the case where lime is used in any proportion.

A. It would make a very great difference in this sense if the water and fat were mixed cold or at a low temperature and the heating were very gradual; then the lime would react at a low temperature—
in fact, below the boiling point—and effect whatever saponifi-
1410 cation it could accomplish at that temperature before the
water had reached such a point that it could directly attack the fat; and, therefore, after those conditions, we could not say, as in the previous illustrations, that the water and lime began their work in saponifying the fat cotemporaneously. The effect of the lime then, at the later stages, might be reduced to its action as a lime soap, if the quantity were smaller than would saturate the entire amount of fat. In other words, if there were lime enough to form a neutral lime soap with all the fat before the temperature reached such a point that the water could act on the fat, there would be no fat left to be acted upon by the water, and hence the water would have in that case nothing to do.

Q. 38. What, if any, difference is there between the glycerine obtained by the Tilghman process and that obtained by the defendants', as recited in their answer?

A. The difference would be that the glycerine obtained by the Tilghman process would contain no lime, and would be highly concentrated because of the small amount of water used. The glycerine obtained by defendants' process would contain some lime, and would, taking the entire product, be very much less concentrated on account of the relatively larger amount of water used in carrying out that process. In both cases the glycerine would contain some offensive matters, derived from the fats or products of decomposition, and would be more or less discolored. If the Tilghman process were conducted in the hot coil I think there would be also, under any conditions of actual manufacture, a considerable amount of acroleine in it. Of course this would not be present where the lower heats and pressures were used.

Q. 39. Is or is not the production of acroleine objectionable, and why?

A. It is objectionable for two reasons: In the first place,
1411 because it represents a loss of glycerine, and, secondly, because it increases the difficulty of purifying the product.

Q. 40. What would be its effect in the establishment where the manufacture was carried on as to the offensiveness of the process of manufacturing?

A. It would increase its offensiveness and, moreover, involve additional precautions, more or less expensive, to prevent such offense.

Q. 41. Is the glycerine yielded by defendants' process fitted for the uses to which glycerine ordinarily goes, without some treatment for the purpose of removing the lime?

A. It is not.

Q. 42. How is the lime removed and when, so far as you know, was this method of removing it introduced or invented?

A. The most efficient method of removing the lime, together also with other little impurities, is the process of distillation. This was first invented and patented, as I understand, in the year 1855, by G. Wilson and G. F. Payne.

Q. 43. Can you state what are the principle uses to which glycerine goes, and about when these uses severally begun to appear to an appreciable extent, so far as you know, or, so far as appears from the literature upon the subject?

A. The principal uses of glycerine are, in the first place, as regards its extent or the amount used, I think, for nitro-glycerine or dynamite. This has come into use within my own recollection during the last 20 years, and chiefly during the last 10 years. Next to this the largest use is that in tobacco. I have not made a memorandum of these dates, because I assisted Dr. Endemann in making the extracts from Wagner's Year Book, which will be put in the case, and I didn't think of making a separate list. This use for tobacco was introduced quite early. Next to that, the use of glycer-
1412 ine in pharmaceutical preparations, which is, of course, very old, going far back of the Tilghman invention, but has been enormously extended and is constantly extending. Glycerine is also, and has been, very largely used in what is called the improvement of wines, and has the effect of giving it some of the characteristics of age, if used in moderate amounts. Very large quantities are used in this way all over the world. It is also used as a preservative for articles of food. It is used in soap, in certain preparations of dye-stuffs, in making copyable printing inks, in making the inking rollers used in all sorts of printing, for preserving leather, in gas-meters, sometimes as a lubricant, and for a great number of similar uses which it is not worth while to take time in enumerating.

Q. 44. If there were testimony to the effect that a larger yield of fat acid had been obtained in any saponification process than that which you have named as the maximum amount, how would you, as a chemist, explain such testimony?

A. By the assumption that the yield of material obtained was correctly stated, but that the assumption that it was a pure fatty acid was erroneous; or, in other words, that the material was not fatty acid, but a mixture of fatty acid with neutral fat.

Q. 45. Would the value of the product as a whole, for the purposes to which fat acids are commonly put, be increased or diminished by the presence of the substance other than fat acid in this product?

A. It would be greatly decreased.

Q. 46. As a process to be carried on, on a manufacturing scale, would or would not the Tilghman process have a practical value, in your opinion, looking to the economical results to be obtained rather than to the illustration of scientific theory? Please give your reasons for any answer you may make.

A. While the Tilghman process would be an admirable illustration of the theory of saponification, I don't think that it would
1413 be practically valuable as a commercial process if used without modification, because the gain which it would secure in the greater purity or a greater concentration of the glycerine liquid obtained would be much more than balanced by the loss of fat-acid products which it would involve. The expense of purifying the glycerine obtained by the Tilghman process and that obtained by the old lime open-tank saponifying processes, for example, would not be as great as the difference in value of a product of fat acid containing, say, 20 per cent. of neutral fat compared with a product yielding 95 per cent. of fat acids. In the old lime-saponification process a portion of the glycerine is left in the water in which the fat and lime have been treated, and another portion remains with the lime soap and is thrown out when that is decomposed by sulphuric acid in the regular process for manufacturing fatty acids. This portion of the glycerine would then be mixed with water, and the slight excess of sulphuric acid present would need to be neutralized by lime, and then the two solutions could be evaporated separately or together, and an impure glycerine would thus be obtained very similar to the corresponding product now produced by defendants. On the other hand, the glycerine obtained by the Tilghman process would simply require concentration to bring it into a parallel condition; but, in either case, the liquids would be dark colored and more or less offensive in taste and smell, and could only be reduced to a condition fitting them for most of the uses to which glycerine is put by distillation or by some parallel treatment, such as filtering through bone-black and treatment with various chemical substances, which would be as expensive as the distillation, if not more so; so that the saving involved in the Tilghman process, as far as glycerine was concerned, would be confined to what are, in fact, rough and cheap preliminary treatments, and would not
1414 effect the most expensive part of the purification, namely, the distillation or equivalent treatment. In practice this distillation for the best grades of glycerine is repeated as many as four times. This is the case, for example, with the product of the defendants' process, which certainly does not escape much of the expense of refining by reason of anything it takes from the Tilghman process. The yield of glycerine would be higher with the Tilghman process, because the less such a material has to be handled and treated the less loss will there be. On the other hand, as I have already pointed out, the loss of valuable fat acid by reason

of imperfect saponification would be very great with the Tilghman process, and as the yield of fatty acids is nearly 95 per cent. of the fat used, while the yield of glycerine is only six or seven per cent., this reduction of value on the larger part of the product would, of course, be serious.

Recess until 2.30 p. m.

Hearing May 17th, 1883, 3 p. m.

Master and counsel present as before.

Examination of HENRY MORTON continued.

By Mr. PARKINSON:

Q. 47. Are you able now to refer more specifically to the work exhibiting the process of analyses of fat acids and other ingredients contained in the product of saponificaiion to which you referred in an answer this morning?

A. I have here the volume of Wagner's Year Book for 1881, published in 1882, and on page 922 it contains a full abstract of
1415 this process of analysis, which was published by O. Hausmann in Dingler's Journal, volume 240, page 62.

Q. 48. In the process of saponification carried on as is described in the Tilghman patent, or as the process is construed under the decision of the Supreme Court as referred to by you heretofore, would there or would there not, in your opinion, be any liability of a reunion to any extent of the component parts of the fat after saponification had begun to take place?

A. I think it quite possible that such a reunion might take place. Berthelot, in 1853, showed that synthesis of the various fats could be accomplished by subjecting a mixture of glycerine and the corresponding fatty acid, or of fatty acid and a lower compound of the same acid with glycerine, to the action of heat and pressure in closed vessels, and it seems to me quite possible, and not only so, but a very probable, explanation of the fact that a perfect saponification does not appear to be obtainable with heat, water, and pressure alone; that such a reunion might occur, and that the fat decomposed at one point where excess of water, for example, was present might be reformed at another point where an excess of fatty acid was encountered. The paper of Berthelot, in which this matter of the synthesis of the fats was first published, appears in the Annual of Scientific Discovery—I think would be its English title—by Liebig & Kopp, for 1853, published in 1853, beginning on page 451.

Q. 49. Using the term Tilghman process in the sense you have given it under the construction of the Supreme Court, what would be the contribution made by it to the practical art of saponification?

A. At the date of this invention it was known that, as a chemical fact, fats would, by the addition of the elements of water, be broken up into fatty acids and glycerine. It was also known that this change could be effected not only by the aid of various alkali-s, but
1416 also by the action of steam at a high temperature. My authority is found for this in the exhibits in this case, being extracts

from a publication by Dumas, on pages 247 and 250 of the record; Pelouze & Fremy, on page 259; the patent of Dubrunfaut, on page 247, and the article of Scharling, on pages 251–2. It had also been published to the world by the description in Roret's Encyclopedia, as I understand it, that by heat under pressure in a closed vessel the amount of lime used in the older process for saponification could be reduced. Now, in this state of the art Mr. Tilghman conceived the original and striking idea that this suggested reduction might be carried to its limit by omitting the lime altogether and effecting the saponification of the fat in a direct chemico-mechanical way by bringing the atoms or molecules into close contact with each other and setting up such violent heat vibrations as would shake them out of their old into new compounds. As a conception in chemistry and its applications, this, I think, was an extremely brilliant idea and apparently capable of practical realization with great utility. As I read the history of the matter it seems to me that this brilliant promise has not been fully realized through difficulties which could not have been anticipated, but which caused this method in a practical way to fall short of that degree of perfection, and certainly in operation, which *are* necessary to the complete practical success of a manufacturing process. Consequently, while it was a great contribution to chemical knowledge in this direction and highly suggestive in this and other directions, it does not seem to have reached a point of practical success, except so far as it was used with modifications which, to a certain extent, were, I think, the outgrowth of the suggestion contained in the Roret extract; in other words, the world at large, left with nothing but the Roret article, would have gone on slowly, step by step, decreasing the proportion of lime in this process and increasing the pressure until a point of greatest prac-
1417 tical utility had been reached by a gradual progression. Mr. Tilghman's device leaps over this series and attacks the problem from the other end, and, as it seems to me, has obtained a practically successful solution of the question by a backward movement in that sense toward the old lime process as proposed by De Milly and indicated in the Roret article. His invention has, no doubt, had a profound influence on the progress of discovery and invention by arousing the attention of the world and of all those interested in the matter and directing it in a right channel.

Referring now to page 585 of the Supreme Court record, answer to question 19, in the deposition of Prof. Booth, do you agree with the conclusions stated therein? Please give your reasons for any opinion you may express.

A. In this answer Prof. Booth states correctly that when superheated steam is passed into a digester comparatively cool, the superherheated steam will be entirely condensed; but he adds "when the water in the digester has been heated to a temperature corresponding to the pressure on the safety-valve of the digester, then the superheated steam will give off to the water only its extra or super degree of heat, which will convert part of the water into steam; this steam and the superheated steam, which will now have lost its superheat and become common steam, will both escape by the safety-

valve." Now, I think, that under the conditions mentioned, the superheated steam would not lose all its heat of necessity to the water, but would act directly on the fat, or any other material in contact with which it came on its entrance, and would thus, to such an extent as it was brought in contact or came in contact with such matter, act as superheated steam, and not as ordinary steam. The degree of this action would depend upon the rapidity with which the steam entered the vessel and the facility it had on entering of coming in contact with such other material.

1418 Q. 51. Referring to page 587 of the same record, I find in the same deposition (being the deposition of Prof. Booth, taken from the case of Tilghman *v.* Werk) the following: "Q. 27. As compared with the old process of using 14 pounds of lime and 36 of sulphuric acid to the 100 pounds of fat, does or does not the process of the defendants show a reduction in the amount of lime used and the quantity of sulphuric acid employed?

"A. It does show such reduction.

"Q. 28. Is or is not this reduction of the quantity of lime and sulphuric acid in defendants' process due to the fact that the chemical power of water at a high temperature and pressure is employed?

"A. It is certainly due to the chemical power of the highly-heated which is employed."

Q. 52. Is the conclusion therein expressed correct, in your opinion, and would it be correct if applied to the process of the defendants in the present cause?

A. I do not quite agree with this statement of Prof. Booth as to its conclusions, because I think that the reduction of the quantity of lime, and, of course, the consequent reduction in the sulphuric acid, is due not only to the chemical power of water at this high temperature and pressure, but to the increased efficiency of the lime secured by the same conditions of temperature and pressure. Prof. Booth himself, a little further on, in the same deposition, at the top of page 589, in answer to question 37, states as follows: "In the third experiment 100 parts of lard were heated with 130 parts of water and 12 parts of lime to 350° F. for six hours. The lard was wholly resolved into lime soap and glycerine." Assuming this to be correct, it would appear that 12 parts of lime under this condition of heat and pressure were able to effect as perfect, if not a more perfect, saponification than was obtained by 14 parts of lime where no such heat and pressure were employed. This would indicate that under such conditions the efficiency of the lime was increased

1419 by the heat and pressure. Indeed, as a chemical fact, one could not doubt for a moment that if lime would combine with the acid of fat at a low temperature it could combine much better and more rapidly at a high one, and the operation in defendants case undoubtedly being discontinued as soon as the result was obtained; that result as obtained must have been partly due to the contemporaneous increased action of the lime upon the fat brought about by the high temperature and pressure, as well as to the action of water, which undoubtedly produced part of the effect. So, as I understand it, the expression that this reduction in the quantity used is due en-

tirely to the chemical power of the highly-heated water would require some limitation to make it correct.

Q. 53. Referring to the same deposition, page 591, of the same record I find the following: "Q. 53. Have you subjected defendants' product of December 17th, 1868, to any mechanical treatment, and, if so, with what result? A. A quantity of defendants' product of December 17th was put between porous papers and gradually squeezed or pressed, at first cold and afterward hot, until it ceased to grease the papers. The substance left between the papers was a hard, dry, white powder, not greasy to the fingers, which was analysed and contained lime 8.9 per cent. and fat acid 9.03 per cent., and was a neutral lime soap. The greased papers were treated with hot alcohol, which was then filtered and evaporated, and left a fluid oil having all the properties of free fat acid. 100 grains of it were burned and left an ash weighing 0.49 grains of carbonate of lime, which is equal to 0.27 grains of lime. This lime was in the state of lime soap, and was dissolved by the liquid fat acid which was absorbed by the paper. Q. 54. Does this separation of defendants' product into two different substances, by purely mechanical means, prove anything as to its nature? A. It proves beyond a doubt that the defendants'
1420 product is a mechanical mixture of neutral lime and soap and free fat acid." Do you understand what product is being spoken of in this quotation? And, if so, please state whether or not the facts there given support the conclusions therein expressed—and you may answer this, first, with reference to the text as quoted; and, second, upon the assumption that instead of 9.03 per cent. is meant 90.3, and that the word "and" should be stricken out from between the words "lime" and "soap" in the last line quoted.

A. If these numbers were taken as here printed they would, of course, fail to indicate that the material left by the process of squeezing and heating was a neutral lime soap; but this is so manifestly a misprint that I think there is no doubt whatever that this correction should be made. With this correction and the removal of the superfluous "and," which renders the answer to question 54 manifestly inaccurate, or, rather, incorrect in expression, I then do not think that the facts stated support the opinions; and it also seems to me that the opinions are liable to be carried further than their strict statement involves, so as to create a further and more important misapprehension. In the first place, I do not think it is conclusive that, because a material, after being subjected to heat and pressure, as is here indicated, yielded two different bodies, therefore no compound other than the two separate ones existed prior to this treatment. There are many substances existing in a state of loose chemical attraction which are decomposed with the greatest ease by nothing but mechanical pressure, and this is so familiar that it is not necessary to do more than allude, in the first place, to various fulminates which the touch of a feather will explode, that explosion, too, being not a combination, but a decomposition. So, likewise, with such loose combinations as carbolic acid and the alkali-s, which I think
would, without doubt, be readily decomposed by precisely
1421 such treatment as is here stated, so that this positive conclusion

seems to me to be quite too broad a one to draw from the premises stated. The inference also that without a little caution might be drawn from this is still further, as I think, from the facts—that is, that no acid lime soap existed when this material was in the act of formation. If I rightly apprehend the part played by the soap in saponifying materials, it is, as I have already described, an action of transportation, as it were, which is constantly going on in the opposite directions at different points during the saponification of the fat; in other words, that a particle of soap, in contact with the excess of fat at one point, becomes an acid compound, and then is reduced to a neutral compound when it comes in contact with the water. This is a view supported, as I undestand, by the experiments made by Pelouze on saponification with soap, and it seems to me that it is perfectly consistent to suppose that such an acid lime soap should exist from time to time during the process of the manufacture of the soap, and yet not be obtained or not found in the manufactured product after that product had been cooled down, withdrawn, and, possibly, treated in other ways, and, at all events, after it had been subjected to such heat and pressure as is here described. The fact that an acid lime soap is not formed by some one particular treatment is, of course, a poor argument as to the impossibility of forming it by any other; and I remember noticing in this connection in one of the depositions that it was stated that neutral lime soap was heated with water, and appeared to be unchanged, and this was introduced as being conclusive that an acid lime soap did not exist, while, according to the theory as I understand it, this treatment would be just the last way in which one could expect to get acid lime soap.

Q. 54. Referring to questions 59, 60, and 61 and the an-
1422 swers thereto, in the same depositions, and on pages 592 and 593 of the same record, please state whether you agree with the conclusions stated therein, giving your reasons for any opinion you may express; and, in this connection, you may state whether or not you have read the entire deposition here referred to.

A. I have read this deposition as far at least as the cross-examination; the direct testimony I have read all through. I have already in a previous answer touched on some of the points that are involved in the matters discussed in the answers to which you have referred. The process here described assumes that the lime, fat, and water are mixed cold, or nearly so, and that heat is then gradually applied. This mode of treatment would not correspond to the process as carried on by the defendants in this case, and even if the conclusions here stated were entirely true under the conditions assumed, as I have already pointed out, they would not be true under the conditions as now produced; but I do not think, as I have already indicated, it is true even under the conditions here assumed, for, granting that by the time the temperature rose to a little above the boiling point the lime had reacted and produced a neutral soap, I do not think that the only subsequent action would be that of the water directly upon the fat, but, on the other hand, consider it extremely probable that the next action, as the temperature gradually

rosé, would be one of the soap, as I have already stated, acting as a carrier between the fat and water, and that it would not be until a considerable increase of temperature and pressure had been obtained that any direct appreciable action of the hot water upon the fat would take place. The facts referred to in this answer in support of this opinion by Dr. Booth are that he examined one specimen manifestly taken from a tank in which the fat, lime, and water had been gradually heated, and found it to be a mixture of neutral fat
1423 and lime soap. This, of course, would be highly probable if the operation were carried on with sufficient slowness, starting at a temperature below that of boiling water and stopping or taking the sample at just about the time that that temperature had been reached. He then examined another sample, taken at a later period, and found this to contain, in addition to the lime soap and neutral fat, some fat acid, and concludes from this that the fat acid here found had been produced solely by the action of the water. This, I think, as I have already stated, is simply an assumption; and I also believe that there is nothing, as far as we know, supporting that view or rendering it more probable than the one which I have stated as to the agency of the lime soap in effecting the saponification at this stage. His third sample, which Dr. Booth found to consist of lime soap and fat acid, with no appreciable quantity of neutral fat, and which was taken from the same treatment and apparatus at a lower stage, is, I think, subject to the same comment.

In the final question and answer referred to the statement is practically made that there are necessarily two distinct stages in the defendants' process, separate in point of time. Now, this I do not think is true, unless certain other conditions which do not appear here are assumed. If this heating was very slow and the mixing very perfect during that time, it is conceivable that, under just these conditions, the formation of a neutral lime soap should take place first, and after that the liberation of free fatty acid by the instrumentality of that soap, as I suppose, or without it entirely, as Dr. Booth assumes should occur; but under any ordinary conditions of working such slow heating would not be likely to be resorted to, and if the heating were at all rapid, then, I think, undoubtedly the two actions would take place largely at the same time. I quite agree with Dr. Booth that, if this slow heating takes place, the direct action of the water upon the fat cannot appreciably begin be-
1424 fore the temperature of boiling water is reached; but I should go further and say that neither could it appreciably develop until a point considerably above that.

By Mr. CHAMBERS: Would you mind estimating that?

Witness continuing: I should suppose that a temperature of at least 50 degrees F. above that of boiling water (262 degrees Fahrenheit) must be reached before any appreciable action between the water and fat would take place, and even then it would probably be very slight.

Q. 55. Referring to questions and answers 89 and 90 of the same deposition, on page 600, and question and answer 124, on page 606, please state whether or not, in your opinion, the experiments here

related are such as persons skilled in the art, seeking to obtain good results, would adopt for the purpose, and whether or not the method described would, in your opinion, be a fair method of carrying out the process referred to, giving your reasons for such opinions as you may express?

A. The answers to questions 89 and 90 contain descriptions of an attempt to carry out the process of Dubrunfaut by distilling, as it is said, lard with the passage of superheated steam through it. Little or no detail as to the apparatus is given, and we can only judge what that must have been by the results produced. But the description itself implies that the idea prominent in the mind of the operator was to distill the lard and not to separate it into fatty acid and glycerine. Professor Booth himself, further on, in the same deposition, page 612, in answer to question 143, describes an experiment showing that there was no decomposition of a neutral fat at a tem-
1425 perature able to melt lead; and in this experiment it is manifest that he obtained a temperature which was able to decompose the lard on which he was acting. This indicates that he must have used a temperature above that of melting lead, and, as Dubrunfaut states that the temperature employed should be between 200 and 330, it seems to me manifest that, from some defect in the arrangement of the apparatus, the temperature was not properly controlled and did not come within the intention of Dubrunfaut. It is not generally realized, even among those who are constantly familiar with the subject, how difficult it is to secure superheated steam of a certain high temperature at any noticeable distance from the place where it is superheated; and, looking at the result of this experiment, in view of my own experience, I should not hesitate to say that the superheated steam used in this case (also undoubtedly unintentionally from lack of the necessary adjustment between the parts of the apparatus) was not superheated to such a temperature as Dubrunfaut suggests in his patent. I was in my own experiment (having had by chance experience in exactly this matter of carrying superheated steam) very careful to have the superheater in the most direct possible contact with the distilling apparatus and placed a thermometer, as my drawing shows, inside of the very apparatus and where the steam entered it; and it was only by this means that I felt assured that I really had superheated steam at the stated temperature where it was required. If such lack of the necessary conditions did not exist, I should be entirely at a loss to understand the results obtained; because, as I have already related in my own experiments the distillation, conducted in essentially this manner, was perfectly regular, easy, continuous, and without the production of the slightest decomposition, such as would develop acroleine; whereas Dr. Booth appears to have got an immense amount of acroleine, a portion
1426 of unaltered fats, and a small amount of fat acid; while in my case the fat acid was absolutely pure, there was no acroleine, and I obtained, I am sure, the full proportion of glycerine which should have come over with the amount of fat acid obtained. In the question and answer 134 Dr. Booth alludes to the research of Scharling, stating that it is like that of Dubrunfaut except that it is

carried on at a lower temperature, and so dismisses it. In view of the evidence of excessively high temperature used by Dr. Booth in his experiment, I feel pretty sure that if he had followed what he understands to be Scharling's process, moderating those conditions of temperature and making sure that the superheated steam was not steam that had been superheated some time or other, but was superheated at the time it acted on the fat, to the requisite temperature, he would have obtained a result closely coincident with my own. On my return to Hoboken I will repeat the experiment made with my own apparatus, to which I have before alluded, making careful notes of the quantities of material and time, and will furnish the results at our next meeting; and I will also note the actual temperature of the fat during the distillation.

(Counsel for complainant desiring at this stage to ask a few questions of the witness, by consent he does so before the direct examination is proceeded with.)

By Mr. CHAMBERS:

Q. 56. During your examination you have frequently referred to Tilghman's process, and have in one or more of your answers distinguished it from other processes; will you please state again, as fully as possible, exactly what you understand to be the Tilghman process?

1427 A. I understand the Tilghman process to be any proces involving the use of heat, pressure, and water in contact with neutral fats for the purpose of saponification or the separation of the same into fat acids and glycerine—this process being conducted in the manner set forth in the Tilghman patent, and with either the apparatus there specifically indicated or with any other apparatus equivalent thereto existing at the time of said patent, and when I refer to the apparatus indicated I not only mean the coil apparatus, but any close boiler provided with efficient means of circulation or mixing, and that I may make my meaning clearer I may say that, as I understand it, this limitation is called for in order that that patent may be kept clear of such methods as that set forth in the Roret extract, where lime or other materials are introduced along with the water and other substances, and by reason of which the patent must be limited to the process as used without such agencies. I also consider that it must be so limited as to exclude other modifications, either in process or in apparatus, which have been made the subject of subsequent patents, such subsequent patents being very possibly modifications and subject to the Tighman patent, but if they are valid patents, of course, not parts of it as such.

Q. 56. Would I be correct in paraphrasing your answer as follows: A process by which fats are decomposed into fatty acids and glycerine by the action of water heated under pressure above 212 degrees, and in which a constant agitation and intermixture of the fat and water is preserved, is the Tilghman process?

A. Provided it is understood that your description includes every-

thing that is claimed for the process, and excludes all that is not stated in it, I would accept your form of statement.

By consent, the further direct examination of this witness is postponed, to be resumed at the Windsor Hotel, New York, on
1428 June 19th, 1883, at ten o'clock a. m., the examination of other witnesses to be proceeded with without prejudice from this postponement.

Adjourned to to-morrow at 9.30 a. m.

1429 Hearing June 29th, 1883, 11 a. m.

Master and counsel present as before.

HERMAN ENDEMANN was recalled for the defendants, and examined by Mr. PARKINSON.

Q. 1. Have you looked over your deposition in this case as it appears in the printed record, and if so, do you find that any portion of it incorrectly represents your testimony as given at the time?

A. The testimony as printed on pages 71 to 91 is full of typographical errors and also errors made by the reporter, and I have taken the printed copy and made those alterations which I have made on the original copy given to me in Cincinnati for the same purpose, as near as I was able to do so. There is also on page 126 of the record, in answer to cross-question 88, instead of "I do not know this to be the fact," to read "I do know this to be the fact."

Q. 2. When you made the corrections in your deposition as written up by the stenographer, how were the corrections for the portion from page 71 to 91 made, on the manuscript or upon a separate sheet?

A. They were originally made upon a separate sheet, and when I was near the end of my task I was allowed to make the alterations on the manuscript.

Q. 3. Do you know whether the alterations were actually made upon the manuscript or simply left to be made?

A. I don't know it, but I believe I made them myself.

Q. 4. Will you produce a corrected copy of that portion of your deposition from page 71 to 91?

A. I hereby produce it.

Q. 5. By whom were the corrections on these sheets made?

A. By myself.

1430 (It was agreed that the sheets produced by the witness may be reprinted as corrected and substituted for the corresponding pages of the record.)

Q. 6. Referring now to your answer to question 56, on pages 87 and 88, please state whether or not you have found you made in that answer any mistake in substance; if so, state wherein.

A. I did make a mistake in that. On returning to New York and looking over my notes I found I was entirely mistaken in regard to the analysis of the second sample obtained by distillation. I do not

think such an analysis has been made by me, and all the assumptions formed and based upon that statement are hereby withdrawn.

Q. 7. Do your notes show the analysis of the first sample mentioned here?

A. They do.

Q. 8. And do you find the statement here correct?

A. It is correct with the notes which I have in my laboratory book.

Cross-examined by Mr. CHAMBERS:

X Q. 9. How did you come to make such a serious mistake in your former testimony with regard to the distillation experiments made by you?

A. The distillation experiments were proposed by Professor Morton, and were originally not within the range of our investigation. I never considered them very seriously, and the importance which has been given to those experiments by long-continued direct examination and cross-examination have brought those experiments in the foreground, while I considered them at the time as of secondary importance.

X Q. 10. Do you think that the fact that you considered these experiments of secondary importance warranted you in stating that you had made certain analyses, determined certain facts, and drawn certain conclusions from these facts, when, as a matter of fact, you had done nothing of the kind?

1431 A. I was not aware at the time that the statement which I had made was untrue. I have been making a great many more analyses than those of which I kept record in this case. These other examinations were made, so to say, for practice and in order to test the method which I employed for the determination of the accuracy of the method. I kept at first all the results until I determined in which manner the analysis should be carried out. Then, afterward, having determined this point, I discarded the results which were obtained by making the analysis in a manner by which satisfactory results could not be obtained. The products which were thus analyzed were those which we had prepared ourselves, and for that reason I thought it might be that I had also examined this sample?

X Q. 11. How could you state, however, on the basis of the confusion in your mind, which led you to think that you "might" have analyzed this product, that you had analyzed the product; not only so, but that you drew a number of inferences from such analysis?

A. I was at the time fully under the impression that I had made the analysis, and it was only after my return to New York that I found out that I had made this serious mistake.

X Q. 12. Are you sure that you ever made any distillation experiments at all?

A. I am.

1432 Hearing June 29th, 1883, 11 a. m.

Master and counsel present as before.

HENRY MORTON was called and his direct examination continued.

By Mr. R. H. PARKINSON:

Q. 57. Have you repeated the distilling experiment referred to in your answer to question 54, on page 298, and if so, with what result?

A. I have done so. As soon as practicable, after my return from Cincinnati, I proceeded to repeat that experiment. I would mention, in the first place, that until my attention was drawn to it by matters in examination, I had not regarded this experiment as of importance beyond the point at which it proved that steam would decompose neutral fat into fat acids and glycerine, and it was for that reason that I made in my first experiment no weighings of the quantities obtained, or any analysis myself as to their composition. The questions which were asked during the testimony, in Cincinnati, having drawn my attention to the possible importance of these circumstances in connection with the experiment, I was careful in repeating it to note everything. The first experiment which I made was on May 23rd, when I took 100 grammes of fresh tallow, which I had myself rendered, and placed this in the still, connecting it as before with the apparatus for supplying superheated steam and heating it as before externally. I had, however, modified the apparatus, as requested by Mr. Tilghman, by introducing a closed copper tube, which would contain a thermometer plunging into the fat, and was thus enabled to note the temperature of the fat during the experiment. Steam was started at 12.10 on the day named, and

1433 continued to run till 6.20, six hours and ten minutes. During that time the temperature of the steam was 280 (corrected by standard thermometer, 276) degrees Centigrade, with slight variations. The thermometer plunged in the tube, which gave the temperature of the fat showed 270 (corrected, 268) degrees. As none of the thermometers used were absolutely correct, I have added the temperatures, corrected by comparison with a standard thermometer in each case. The thermometer in the anthracene bath showed 281 (corrected, 279.5 degrees C. The amount of fat acid which distilled over was 93 grammes, weighed, however, without any attempt to dry it, so that this weight is slightly in excess, and the residue in the still weighed 8.7 grammes. The glycerine obtained from the water weighed 5.23 grammes. On testing the fat acids, I found that they contained 83 per cent. of pure fat acid, the rest being neutral fat. The amount of steam condensed was 1,060 grammes—in other words, about ten times the amount of the fat used. The residue left in the still was entirely uninjured, and I have it here. I here produce the residue in question, not as a permanent exhibit, because I am quite certain that it will become rancid in time, but I will ask the master to note at the present time it shows no sign of decomposition or of any injurious effect from the heat to which it had been exposed. The smallness of the quantity of this residue shows mani-

festly what is the fact, that the only limit to distilling the entire substance was the impossibility of making the steam traverse the very small quantity of fat left at the bottom of the vessel, which was not enough to cover the outlets for the steam. The glycerine obtained from the water I have here, and it is quite sweet, free from empyreumatic odor or taste, and I think quite as good as the average crude glycerine. I did not determine its density, the quantity being small, but concentrated it to the same degree that I did other samples obtained by the Tilghman process, and with which
1434 I have compared it. I may say here that I do not regard the amount of yield of glycerine obtained in so small an experiment as having any significance as to the commercial value, since the losses in such small operations are out of all proportion greater than those conducted on a commercial scale.

On the 25th of May I repeated this distillation experiment, with a slight modification of the temperatures employed. Here again, I took a hundred grammes of the same fat, but had the temperature of the superheated steam at 295 (corrected, 291) degrees C. The thermometer in the fat showed 286 (corrected, 284), and that in the anthracene 298 (corrected, 296.5). The steam was started at 10.50 and stopped at 1.30; the experiment, therefore, lasted two hours and forty minutes. The amount of fatty matter distilled over was 75 grammes, and the residue in the still weighed 23 grammes. The amount of glycerine was 2.67; the fatty matter distilled over showed 80 per cent. true fat acid, the balance being neutral fat. The condensed steam amounted to 400 grammes or four times the weight of the fat treated. In this case there was some smell of acroleine, and it will likewise be noticed that the fat acid was less pure than before, and that the time of the distillation was very greatly reduced. The glycerine obtained I here produce, and the residue also, as a temporary exhibit. It will be noticed that the residue in this case likewise had suffered no decomposition or change other than the acquisition of color from the copper vessel, and the larger amount here present is simply the result of my stopping the operation at a little earlier point, as it was impossible to see inside of that vessel; this stopping, when I supposed the fat was about exhausted, was a matter of guess-work, but beyond doubt by continuing a little longer the residue in this case could have been reduced to the same amount as in the other. In order to get some notion as to the affect of
1435 rapidity in current of steam, I made another experiment on June 6th, in which I again took 100 grammes of fat, started the steam at 3.30, continued it until 6 o'clock, making the current very slow. The temperature of the steam was 283 (corrected, 279). The thermometer in the fat was 270 (corrected, 268), and the thermometer in the anthracene was 280 (corrected, 278.5). In this case I collected only 14 grammes of distilled fatty matter, leaving a residue of 85 grammes in the still. The amount of glycerine obtained was only a few drops, but the fatty matter distilled showed 86.5 per cent. of fat acid. The steam condensed was 250 grammes, or two and a half times the fat in the still.

Again, on June 16th, I made another operation in which I used

100 grammes of fat in the still, turned on the steam at 4.30 and ran it till 6.50, or two hours and twenty minutes. The temperature of the steam was 273 (corrected, 274), the current very slow; the thermometer in the fat 285 (corrected, 283), and the anthracene 295 (corrected, 293.5). I should here note that when the current of steam was very slow, it was impossible to keep up the temperature of the superheated steam, even though the tube in which it was superheated was at a bright red heat, it lost heat so rapidly, even in the distance of a few inches which separated the superheater from the tube in the still which contained the thermometer. In this case the amount of fatty matter distilled over was 10 grammes. There was again obtained only a few drops of glycerine. The fatty matter showed 88 per cent. of fat acid, and the condensed steam amounted to 200 grammes or twenty times the weight of the fatty matter distilled over. From these various experiments it seems to me manifest that the process of distillation, as we have called it, with superheated steam, will not yield a pure fatty acid, as I had before supposed, but only one varying from 80 to 88 per cent., according to the rate at which the process is carried on, essentially, in such an
1436 apparatus as I have used. Modifications in the form of the apparatus by which more time was allowed for the reaction of the steam and fat before its escape from the vessel would, I think, enable us to obtain a better result, but what I have stated is the best result that I could obtain with the apparatus employed. In this connection I may properly mention that in my previous testimony, in allusion to the experiments tried more than a month ago, I stated that the product of distillation, on analysis, showed 99 per cent. This statement, as I think was manifest, was made simply on the strength of Dr. Endemann's reported analysis, which I assumed to be correct and accepted, and of course anything in my testimony resting on this statement, will require modification, as the result of these experiments and analysis made by myself, which modify the above statement, as is manifest.

Q. 58. Do you find any viscid or tarry matter in the residue from the distilling experiments?

A. None whatever; nor do I believe that any would be produced except from some dirt or impurity in the fat operated upon or from the use of some strong acid, like sulphuric acid, in connection with its preparation.

Q. 59. Have you made any analysis to ascertain the per cent. of fat acid yielded in the laboratory experiments referred to by you in the earlier part of your deposition as having been made at your laboratory?

A. I had made a number of determinations after my return from Cincinnati. In the first place, I determined over again the fat acid in the product obtained by me where I heated fat with water alone in a digester, mentioned by me on pages 251 to 253 of the printed record. On repeating my analysis of this product, I obtained, in two separate determinations, 68.8 and 70.8 as the amount of free fat acids. This result, it will be noticed, differs by about

eight per cent. from the determination made by Dr. Ende-
1437 mann and referred to by me in my earlier testimony. The cause of this variation is due to two things. In the first place, the material operated upon by Dr. Endemann was the fatty mixture as taken from the digester, and which, on examination, I found to contain a certain amount of lead which it had combined with from the lead lining of the apparatus. This I removed in my experiment by sulphuric acid before making the test, and though it is a question in my mind as to whether this was or was not the fairest way of making the determination, I preferred to do it, because, if there is any question, this method of making the determination is the most favorable to the Tilghman patent; in the second place, the fatty matter during the time that had elapsed since the first analysis was made by Dr. Endemann, had become noticeably rancid or had acidified, which would also tend to raise the result.

The next determination I made was with the similar product obtained by me in the same apparatus under the same conditions of heat and pressure, but with the addition of one per cent. of lime. This is referred to in my testimony, in the printed record, at the top of page 266, in answer to question 18. This substance, when again examined, showed in two determinations 90.6 and 92 per cent. of free fat acid. It will be noticed that Dr. Endemann's analysis, to which I have referred in my previous testimony, showed 84 per cent., and I explain this difference on two grounds. In the first place, that in preparing the material for analysis Dr. Endemann used only that amount of sulphuric acid which he calculated was the chemical equivalent of the lime contained. As there was lead present in this sample, likewise obtained from the lead lining of the vessel, and as, in my opinion, this amount of sulphuric acid would not have perfectly removed the corresponding quantity of lime, I thought it best, in my preparation, to use an excess of sulphuric acid, which would remove all the lime and the lead before testing. This,
1438 of course, would make the experiment and the test fairly comparable with the other made by me. I should also state that this product likewise was decidedly rancid when I made my test upon it. Now, it will be noticed that when these two results are compared it is a matter of indifference whether we take Dr. Endemann's original analysis or my more recent ones. In either case the difference between the treatment with water alone and the treatment of lime is a difference of about 22 per cent.

I also tested recently the material sent me by Mr. Gamble, which was prepared by him, by heating fat and water without lime in one of his large digesters, referred to by me near the top of page 272. This product (being also noticeably rancid), on retesting recently, gave 92.46 fat acid, instead of 88.81 as determined by Dr. Endemann and reported by him to me. Now, it so happens that this was the very product which I selected before going to Cincinnati to use as a means of testing the accordance of my analysis with Dr. Endemann's, and two tests made at that time (about a week or ten days after Dr. Endemann's analysis) showed respectively 90.1 and 90.6, which results I considered at that time, and consider now, as being in essential

accord with Dr. Endemann's 88.81, a difference of about one per cent. between two observers with the material subject to change, and which had stood a week or ten days between, being quite as close as one ought to expect it; in fact, the difference was exactly in the right direction. I therefore considered at the time, as I now consider, that this result was a full confirmation of the accuracy of Dr. Endemann's work. Finally I have recently made tests of the other product sent me by Mr. Gamble, mentioned, and find as a result of three separate analyses the following numbers, 94.3, 94.4, 94.9, instead of 97.5, as stated on page 272. This would indicate an error of about two and a half per cent. in the analysis of Dr. Ende-
1439 mann in this particular substance, but this I do not consider to be anything more than such a variation as might fairly occur in the work of two experimenters employing a test of this nature where absolute certainty of result within a per cent. or two is not to be looked for, and where close comparisons can only be made between tests conducted by the same experimenter, under essentially identical conditions.

Q. 60. How far, if at all, do you regard the variations in the result of these analyses as materially affecting the opinions you have expressed in your deposition?

A. I don't regard these modifications as in any way affecting the conclusions stated by me; in fact, I regard them as substantially confirming the previous depositions in all respects. The variations, where they amount to anything, are only such as would result from the difference of treatment which I have explained, and the fact that the fats, where they were only partly saponified, have acidified or become rancid. It will be noticed that it is precisely those fatty mixtures which contained large amounts of undecomposed fat which have changed noticeably. Those which were well decomposed to begin with, of course, have suffered little change. In fact, my conclusion is from these very analyses that the results obtained by Dr. Endemann were correct as reported by him and referred to by me.

Q. 61. You have referred to certain samples as prepared by Procter & Gamble at your request. How were these received by you, and how identified?

A. They were received by express in boxes, which contained in each case a single bottle, marked with a label, and I have these bottles, with their original labels, now in my possession; but I identified them at the time by the date on the labels and letters received from Mr. Procter, either by mail at the same time or, in one or more cases, in the box with the bottles.

1440 Q. 62. Did these labels indicate how the samples were produced?

A. Only by the date. The letter described the method of production.

Q. 63. In your testimony, with reference to these samples thus received, have you assumed them to correspond to the description thus received?

A. I have.

Q. 64. Can you cite further illustrations of the sense in which the term saponification is used by chemical authority?

A. I can. I would refer, in the first place, to an article in the "Compte-Rendu," or Minutes of the French Academy for December 5th, 1855, page 973, which I have here, being a communication entitled "Upon the saponification of neutral fats by soaps," by J. Pelouze. A translation of this article will be found at pages 908 and 909 of the record. In this article the term saponification is continually used to indicate the separation of the neutral fat into fat acid and glycerine, even where the final result was free fat acid as well as free glycerine. I would refer, also, then, to the work entitled "Precis de Chimie Industrielle," by A. Payen, of which I have in my library an edition of 1859, but am confident that the passage referred to is identical with the same as given in the edition of 1851, said passage being referred to in the testimony of Dr. J. Lawrence Smith in his answer to question 158, on page 327 of the record. I translate and read the passage referred to, which is as follows: "At this temperature, and under the influence of a current of steam, the transformation (into fat acids and glycerine) of the last portions of the neutral fats is achieved," this passage, occurring in the chapter describing the various modes of manufacturing fatty acids, and having, at page 91, the sub-title "Theory of sulphuric saponification," and also, following, the sub-title, "Treatment called
1441 acid saponification," of which treatment this passage describes a part. I would also refer to Morfit's Applied Chemistry—Soap and Candles—of which I have the edition in my own library, of 1856, but believe, as regards the matters referred to, this is identical with the earlier edition of 1852, referred to in the record. On page 480 I find the following sub-title: "Saponification by sulphuric acid." Under this again a title, "Saponification," under which is described the treatment with sulphuric acid with washing, and the distillation.

Q. 65. What comparison have you observed between the products obtained by the distillation process and those obtained by the water process, without lime, respectively, where used for the same length of time?

A. I find that even taking the highest results as regards the analytical examination of the product obtained by me on a small scale and with exceptionally good conditions as regards stirring or mingling of the fat and water, the best result obtained by the water treatment was a fatty mixture containing 70 per cent. of free fat acid, while, by the distillation process, the worst result was 80 per cent. where the operation was hurried through; and where the operation was carried out in the same time as the water process, being six hours in each case, the result was a mixture containing 83 per cent. of fat acid. As regards the yield of glycerine, this was a little better in the case of the distillation process in proportion to the material operated upon than in the other. Thus in the water process, with the digester, which has already been fully described, and where I obtained a fatty product containing about 70 per cent. of fat acid, the yield of glycerine was 22.9 grammes when concentrated to the

same point as the glycerine obtained from the product of distillation from 500 grammes of fat. In other words, this would be four and six-tenths per cent. where the distillation product was five and one-quarter per cent.

1442 Q. 66. Can you cite further authorities in confirmation of your statement in answer 25 on page 270, relative to the formation of acid salts?

A. As I mentioned in that answer almost any book on chemistry would furnish such citations, but, to carry the date well back, I will refer to two, namely, Encyclopedia of Chemistry, by Professor J. C. Booth, published in Philadelphia in 1850, where, on page 889, he mentions not only one acid soap or bi-stearate of potash and its corresponding soda-salts, but two, the second being, as he calls it, a quadri-stearate; also the Traite de Chimie, by M. le Baron L. J. Thenard, published in Paris in 1835, vol. 4, page 141, where, on this and the succeeding page, he also speaks of the acid stearates of potash and soda.

Q. 67. Please make and offer as an exhibit in this case an extract from Booth's Encyclopedia referred to in your last answer, containing the passage there cited, to be marked "Defendants' Exhibit Booth's Encyclopedia."

A. I will do so.

Q. 68. Have you made any tests of the accuracy of the alcoholic process of determining the per cent. of neutral fat present in any body of fat acid; and, if so, with what result?

A. I have. In the first place, I would say that the question of the amount of alcohol to be used was at the outset an open one, and I consulted authorities and found in a recent publication, being the Chemisch-Technische Analyse, by J. Post, 1881, at page 622, directions for such a test, which he states may be used for purposes of comparison in a factory or the like. Following his suggestion, I took 10 grammes of a fat containing 70 per cent. of free acid and 30 per cent. of neutral fat, and dissolved this in 500 grammes of a hot alcohol of between 95 and 96 per cent., known as Webb's alcohol. On cooling this deposited 4.4 per cent., which, according to this
1443 method of analysis, would be all that was found to represent the 30 per cent. of neutral fat which was actually in the mixture. The test in this approved form having turned out so unsatisfactorily, I next dissolved five grammes of the same fat mixture in a hundred C. C. of 35 per cent. alcohol, and this on cooling gave me twelve and one-half per cent., which in this case was all that the analysis showed of the 30 per cent. of neutral fat actually contained in the mixture. These experiments therefore confirmed my previously expressed opinion that the treatment with alcohol was a poor way to find out how much neutral fat exists in a mixture of such fat with fat acid.

It is agreed by counsel that the exhibits offered in evidence in connection with this deposition shall be governed by the stipulation on pages 144 and 145 of the printed record.

Q. 69. Will you produce a table, being a compilation by you,

showing the pressures in atmospheres, in pounds per square inch, and the corresponding temperatures in Fahrenheit and centigrade?

A. I here produce it. I compiled it from Graham's Chemistry for the pressure and temperature, Fahrenheit, and from Fowne's Chemistry for the relation between the degrees of Fahrenheit and centigrade. I have simply expressed the temperatures in whole degrees, without taking notes of fractions.

The table is here offered in evidence as "Defendant's Exhibit Table of Pressures and Temperatures."

Adjourned till to-morrow, June 30th, 1883, at 10.30 a. m.

1444 Meeting June 30th, 1883.

Master and counsel present as before.

Examination of HENRY MORTON continued:

Q. 70. Have you made a comparative table, showing the results of the analyses of products of the digesters made by you and Dr. Endemann, respectively? If so, please produce it.

A. I have prepared such a table and here produce it.

(Table referred to is offered in evidence and marked "Def'ts' Exhibit Table of Analyses.")

Q. 71. Do either of the authorities cited by you yesterday recognize or illustrate the fact that saponification could be effected by water in the form of steam, as referred to in the earlier part of your deposition?

A. Both Payen and Morfit state this fact. The passage in Payen I translated yesterday, and it occurs in my deposition in answer to question 64. The passage in Morfit is as follows: "The action of steam at this high temperature has the effect of changing any remnants of undecomposed fat into fatty acids and glycerine." And I would also remark that this fact, recognized so early, as these references show, is also accepted in one of the latest books to which I have already had occasion to refer, viz., the "Commercial Organic Analysis" of A. H. Allen, published in Philadelphia in 1882, where, in volume 2, page 119, I found as follows: "*Saponification.*—When
1445 fatty acids are distilled with superheated steam they react with the elements of water, and are decomposed into fatty acids and glycyl-alcohol, glycerol, or glycerine, according to the equation—

$$\left.\begin{matrix}(C_3H_5)'''\\F_3\end{matrix}\right\}O_3+\left.\begin{matrix}H_3\\H_3\end{matrix}\right\}O_3=\left.\begin{matrix}(C_3H_5)'''\\H_3\end{matrix}\right\}O_3+\left.\begin{matrix}H_3\\F_3\end{matrix}\right\}O_3."$$

Q. 72. Can you now produce the extract from Booth's Encyclopedia, referred to in your deposition of yesterday, question 67?

A. I can, and do.

(The same is here offered in evidence and marked "Def'ts' Exhibit Booth's Encyclopedia.")

Cross-examination by Mr. CHAMBERS:

X Q. 73. Did you, personally, make the experiment which you described in the first part of your answer to question 9, on pages 251 to 253 of the master's record?

A. I did.

X Q. 74. What, if any, assistance did you have in making this experiment?

A. I had the assistance of my regular assistant, Dr. William E. Geyer, and also that of Dr. Endemann.

X Q. 75. State exactly what you personally did in this experiment, and what was done by your assistants.

A. I will describe the operation in the order in which it was carried out as the clearest way of indicating exactly what was done by each. In the first place, the fat and water were weighed out by my assistant, Dr. Geyer, under my direction and observation, and placed by him in the digester. I think he and I together lifted on the cover of the same, and I assisted him in attaching the bolts by which it was held; then one of us, I forget which, lit the Bunsen burner under the digester, and one or other, from time to time, as
1446 they might happen to notice it, adjusted the flow of gas, so as to keep the temperature regular. Dr. Endemann also occasionally took a hand in this, for in this experiment, as nearly as I recollect, I was at times absent from the room, going out certainly for lunch, leaving either Dr. Geyer or Dr. Endemann in charge while I was away, or both of them. I noticed myself the pressure on the pressure-gauge and the temperature by the thermometer frequently, and I also attended to the operation of the stirrer, adjusting the resistance to the electric current by which the motor was worked, or occasionally, where there was some difficulty, starting it by hand. The note of temperature was written down in the laboratory book, I think, always by Dr. Geyer, whether from his own observation or at my dictation when I made the observation. When the operation was concluded, and the vessel had become sufficiently cool, Dr. Geyer and I, as far as I recollect, unscrewed the bolts, though Dr. Endemann may have helped. The vessel, after being opened, was allowed to become entirely cool, and then the cake of fatty matter was lifted out by Dr. Geyer and placed on a dish, where it was cut up, a part of it given to Dr. Endemann, and the rest put in a bottle and retained in my laboratory. During this operation I did not make a note or charge my memory with the exact portion of the manipulation done by myself, since I regarded everything that was done, whether by myself or Dr. Geyer, as done by me, under my direction, and as being something for which I was individually and personally responsible; but, to the best of my present recollection, the respective parts which he and I and Dr. Endemann took in carrying out this operation were as I have described it.

X Q. 76. You did not mention Dr. Geyer's presence and assistance in this experiment before, did you?

A. I did not. It never occurred to me to do so. Dr. Geyer
1447 has been my personal assistant for more than ten years, and

for the last four years has lived with me in my house, and is, therefore, practically, to me like another pair of intelligent hands.

X Q. 77. Do I understand that your relations with Dr. Geyer are such that if he tells you that he has done certain things you feel at liberty in the deposition to state that you personally did these things, without reference to the fact that it was done by your extra pair of hands?

A. Not precisely to the extent you name, but, if work was done in which Dr. Geyer took a share under my supervision, I should certainly regard that as my own personal work, and should feel perfectly authorized to speak of it as such, though, of course, ready to admit his assistance if any question were raised on that subject.

X Q. 78. In that portion of your answer to question 9 which I referred to in my first cross-question, you speak of an analysis of the product of the experiment described. What knowledge have you of this?

A. The knowledge obtained by operating in the same method on another sample, and obtaining in several determinations accordant results which were in substantial agreement with those reported to me by Dr. Endemann as obtained by him with the same substance.

X Q. 79. Do you mean by "another sample" another sample of the product of this same experiment?

A. I do not. I mean another sample of like materials—that is, of a mixture of neutral fat and fat acid obtained by water saponification.

X Q. 80. Had you at the time you testified in answer to question nine made any analysis of the sample referred to?

A. I had not. Had I done so, I should have so stated, and I used the language found in that answer, with the intention of conveying
the impression that I had verified Dr. Endemann's method,
1448 and felt satisfied as to the correctness of his results otherwise
than by repeating his analysis on the same substance.

X Q. 81. The language used by you was as follows: "A portion of the same was taken by Dr. Endemann, who was present throughout the operation, and analysed by him. This analysis I verified, and the result was 61.82 per cent. of free fat acid." Do you not think that this language was calculated to and would inevitably convey the idea to any reading it that you had verified this particular analysis and had found 61.82 per cent. of fat acid, as stated by you?

A. This was not the idea in my own mind when I made the statement, but it is possible that a reader might get this impression if he did not consider that had I meant what you suggest I should certainly not have hesitated to say so precisely. As I gave this testimony these words "this analysis I verified" were interjected as a parenthesis, though they here appear as the beginning of a particular sentence.

X Q. 82. In again referring to this experiment and to this analysis, you stated yesterday in answer to question 59 as follows: "On repeating my analysis of this product I obtained the two separate determinations 68.8 and 70.8 as the amount of free fat acids." Do

you not think that this language is calculated to mislead anybody into thinking that you had made a prior analysis of this product?

A. I agree with you in looking over this that this form of statement is misleading, though nothing of the sort was intended by me. The word "repeating" there used had in my mind only a reference to the two analyses quoted, but, as it stands in the record, it does convey the idea (which I did not intend) that these analyses were repetitions of an earlier one made by me.

X Q. 83. Is it not the fact that your deposition, including that part printed on page 253, was submitted to you for correction
1449 and was corrected by you before it was printed, and have you not this morning read over and made corrections in your deposition of yesterday?

A. In the first place, it is true that the testimony on page 253 was read over and corrected by me, but as the idea of the erroneous construction of my true meaning, which you have suggested, never occurred to me at that time, I did not notice this, which I should have corrected had I noticed it. In reference to my deposition of yesterday it is not true that I have this morning or at any other time read it over, though it is true that I made certain corrections which were suggested to me by an examination of the testimony taken in Cincinnati, which I made last evening.

X Q. 84. In testifying about this analysis Dr. Endemann stated, top of page 74, that he found that the mixture contained 61.83 per cent. free fat acids, and on page 253 you state the result as 61.82 per cent. Would not this discrepancy in figures, slight as it is, confirm the impression one would get from reading your testimony that your verification consisted of a different analysis of the same product?

A. It undoubtedly would, but this is the first time that I have noticed this discrepancy. The figure given me by Dr. Endemann, which I have on my original notes, was 61.82, and it therefore seems to me that the discrepancy must either have been from a misprint or some other source of error in Dr. Endemann's testimony.

X Q. 85. Please state why in making this experiment you used a pressure not exceeding 90 pounds, and also why you did not continue the treatment longer than six hours.

A. The reason for both these consisted essentially in the difficulty of keeping the stirring device in operation under high pressure for a long time. *A priori*, I had no special reason for using one pressure rather than another, or one time rather than another,
1450 except that I wished to use a sufficient pressure and time to obtain a decided effect, but in making the experiment I found that 90 pounds pressure was as high as I could go and keep the stirring device from leaking, and by the end of six hours I began to have trouble even then, with the tendency of the stirrer to stick in the stuffing-box or to leak. I believe that while we were conducting this experiment Dr. Endemann and I discussed the question as to the time and pressure, or temperature, which amounts to the same thing, and that he suggested some reason why this temperature or pressure should be selected on the ground of its having been used

by some one in the literature of the subject, but I do not now recollect what this was. Practically we were limited by the conditions of the apparatus.

X Q. 86. As a matter of fact the experiment was an incomplete experiment?

A. Not as I consider it. The object of the experiment was to determine the efficiency of lime in effecting saponification under pressure, and for this purpose it was desirable to make comparative experiments at as many different pressures as possible, which should be alike in everything else except the absence of the lime in one and its presence in the other of each pair of comparative experiments or tests. The experiment to which you allude was one of such a pair. Another similar pair is found in the two experiments made by Dr. Endemann and I with the large digester at the works of Mess. Procter & Gamble, and a third in the pair of experiments made, at my request, by Mr. Gamble, the results of which are indicated in the table of tests, as well as in some parts of the testimony. In fact, this table of tests will be very convenient as expressing readily just this comparison, since I have grouped the tests together on that table in such a way as to show that relation which was the one prominent in my own mind when the tests were made.

1451 X Q. 87. You did not say anything in your former deposition about the sticking of the stirrer. Why didn't you mention this?

A. Unless my memory is very much at fault, I did where I describe the apparatus. On page 253 you will find as follows: "But it required several experiments to get this part of the apparatus running satisfactorily, when the high temperature and pressure were obtained, as there was great liability at that time for the stuffing-box to leak or to offer too great resistance to the rotation of the rod."

X Q. 88. Do you not think that the language you have quoted would lead anybody to suppose that you had obviated the difficulties you speak of, and that in this experiment the apparatus did run "satisfactorily?"

A. I do; and such a conclusion would be perfectly correct. That is what I intended to convey. Using the apparatus at a pressure of 90 pounds, it did run satisfactorily for six hours, so as to keep the materials in a far more perfect emulsion or mixture than is obtained, as I imagine, with any of the commercial forms of the apparatus which I have seen; but this by no means implies that the apparatus would have been in a satisfactory condition for a pressure of 150 pounds, or for an operation of 10 or 12 hours. The problem before me being to make, as I have already said, comparative tests at various pressures and for various times when I found a difficulty in using high pressures for a long time with the apparatus which I had caused to be constructed, I concluded to confine those experiments to such pressures and times as I could use successfully, and to make the experiments of higher pressures and longer times with the commercial apparatus at Mess. Procter & Gamble's.

X Q. 89. The next experiment which you describe in your answer

to question 9 was the one made at Procter & Gamble's factory
1452 on May 10th and 11th. You state that the product of this experiment, after nine hours' treatment, contained 76.47 of free acids. Did you make this analysis yourself?

A. Dr. Endemann and I, as I state in the same answer, made this and a number of other analyses together at the medical college in Cincinnati, and in this sense I made it myself, since I took part in the operation, conducting portions of the process, while Dr. Endemann was carrying on others, and also observing the results with him—that is, watching the change in color and looking at the level of the liquid in the burette, so that it was as much my analysis as his and as much his as mine, except that, of course, we got through in a given time considerably more work than either of us could have accomplished alone.

X Q. 90. Who prepared the test solutions for this analysis?

A. Dr. Endemann brought them with him from New York, but the first thing we did in Cincinnati was to determine the relation of the two liquids used to each other in a quality of the alcohol which we found at the college, and in this I assisted Dr. Endemann, so that it was really of no consequence where the test solutions had come from prior to their being thus standardized.

X Q. 91. How did this determination agree with the preceding one of Dr. Endemann?

A. I don't know how any comparison is possible, since in no case did we then operate upon the same substance which we had tested before. There was, however, one difference in the method of working in this test as compared with some that Dr. Endemann had made before, in so far as the preparation of the materials to be tested was concerned—that is to say, when we were working together we followed the plans that I have always used of treating the fat where it
contained lime with a slight excess of sulphuric acid, so as
1453 entirely to decompose any lime soap which might be present, whereas Dr. Endemann, in some of his previous tests, as I have already explained, added to the fatty material only the calculated amount of sulphuric acid, whereby, as I think, some undecomposed lime soap, where lime was present, or lead soap, where lead was present, would remain in the material when it was tested, and would, therefore, give a low result of free fat acid.

X Q. 92. You misunderstand my question—I intended to ask you how the test of the different reagents or standard solutions of acid and alkali, which you state you made at the medical college, agreed with the previous test of these solutions made by Dr. Endemann?

A. I do not know anything about that, nor, as far as I understand the matter, would it be of any consequence whether it did or not; in other words, the real question in every use of this method of analysis is, What is the ratio of neutralizing effect between the acid and alkaline solution which you are then using in the alcohol you then employ? the importance as to alcohol arising from the fact that it is not uncommon to find traces of acid in alcohol, which, however, have no effect upon the result when the precaution is taken of de-

termining the ratio of the acid to the alkali in the same quantity of alcohol that is used in the subsequent tests.

X Q. 93. The accuracy of the tests used by you and Dr. Endemann depends, does it not, upon the accuracy of the observer in determining a certain shade of color?

A. Hardly; since I think it would be impossible unless the observer were color-blind for him to encounter any difficulty in determining whether a solution were of a rose-pink color, or of a pale yellow, or colorless, and the variations through all this difference would be effected by one or two drops of the test solution.

1454 The conditions of accuracy in this test, as I consider it, are the care in adding the acid and alkali solutions, making sure that a considerable excess of alkali is added previous to boiling and continuing this boiling for a sufficient time.

X Q. 94. Each of the analyses given on pages 254 and 255 are the result, I understand you, of a single test?

A. That may be so, though in several cases we made two or three determinations, but I cannot now recall whether that was or was not done with these particular samples.

X Q. 95. In speaking of these and other analyses made at the medical college, Dr. Endemann says they were under unfavorable circumstances, and that the preparations were not so complete as he would like to have had them. Am I to understand from your not having mentioned any unfavorable circumstances or want of sufficient preparation that you do not agree with Dr. Endemann as to a possible source of error in these analyses?

A. I think such an understanding is substantially correct. The only criticism that I heard Dr. Endemann make at the time was that, not having an accurately standardized normal solution of sulphuric acid for use in decomposing the lime soap in the samples, he was unable to use what I may call his method, of only adding the calculated amount of sulphuric acid to neutralize the amount of lime believed to be in the sample, and was therefore obliged to take my method of adding an excess of acid. Beyond this there was no lack of anything (except the fact that Dr. Endemann was not in his own laboratory and naturally did not feel as much at home), with the exception of one point. Having a great many analyses to make, we were not through when it began to grow dark, and there being no means of lighting the laboratory, we were a little hurried

1455 with the last determination, which happened to be the sample heated with water and lime, at Cincinnati, on May 10th. Being somewhat hurried on this account, we were in doubt whether we had sufficiently dried the fatty matter, after treating it with sulphuric acid, before weighing it, and therefore Dr. Endemann went back to the medical college early Monday morning, May 14th, and repeated his analysis on this. When I saw him afterward he told me that his result was practically identical; but this will explain the difference in the analysis shown on my sheet of comparative analyses, being the fourth pair, which I have marked with an asterisk, where Dr. Endemann reports 88.07 from a combination, probably, of the result he obtained alone with that which we ob-

tained together, while I report 88.85, which was the result we obtained together.

X Q. 96. Do I understand correctly from your answer that Dr. Endemann did not altogether agree with you as to the merit of what you call your method, as distinguished from his method?

A. Dr. Endemann considered my method as too favorable to the other side, since, in the water experiments, it gave the Tilghman process the benefit of any saponification which might have been obtained by the accidental presence of lime, or lead, or copper, or any other material capable of forming a soap. In this view I cannot say I disagree with him, but I consider it safer to take a position where my results would be, if anything, in favor of the other side, rather than to stand on a, perhaps, narrow ground, that might be called in question in some way.

X Q. 97. Apart from your confidence in Dr. Endemann's skill, can you swear, as a matter of fact, within your own personal knowledge, derived from the share which you personally took in these analyses, that they are correct?

A. Had Dr. Endemann been entirely without chemical experience it would have been possible that some errors might have
1456 been introduced which I could not have noticed, but I feel quite as confident, under the existing circumstances, that the analyses were correct as though I had made them entirely myself.

X Q. 98. You are aware, are you not, that in the experiment described on pages 254 and 255, the pressure in the tank, instead of being 150 pounds, as shown by the gauge, was really only about 131 pounds?

A. I am.

X Q. 99. You state on pages 254 and 255 that you continued the treatment of the fat with water alone for 18 hours, and in speaking of the treatment in the companion tank, on page 267, you only mention one sample, taken at the end of nine hours. Did you not also continue the treatment in this tank for 18 hours?

A. I did not. I concluded or assumed that the saponification, where the lime was present, was practically complete, and therefore allowed the workmen, after I had taken the sample, to empty the tank and recharge it in the usual course of the business, as I did not at that time see any reason for further interrupting the work of the establishment.

X Q. 100. You consider, then, a material consisting of 88.85 per cent. of free fatty acids and the remainder neutral fat as, practically speaking, completely decomposed?

A. I do not; but at that time I did not realize the importance of the changing of the water, which was usual in the commercial operation, but which had been omitted in this case in order to render the two pair of experiments, the one with and the one without lime, identical. Had I thought of this at the time I should probably have continued the experiment, but it simply did not occur to me.

Recess for lunch.

X Q. 101. Did you make any experiments which would
1457 enable you to form an opinion as to the relative efficiency of a treatment with and a treatment without lime, both being at a pressure of about 131 pounds, and both being continued for a period of 18 hours or thereabouts?

A. I did not.

X Q. 102. At the time you were making these experiments, you knew, did you not, that during the period covered by this accounting the defendants used in their process the pressure of between 200 and 250 pounds to the square inch, and continued the treatment from nine to ten hours?

A. I did.

X Q. 103. Now, since, if I understand you correctly, the object of these comparative experiments was to determine what you conceived to be the advantage accruing to the defendants by reason of their use of one per cent. of lime, why didn't you take the same pressure and the same periods of time which they actually used at a time this advantage accrued to them, if at all?

A. Because I was unable to do so. I understood from Mr. Gamble that one motive, if not the chief one, in reducing the pressure was a feeling of insecurity in reference to the boilers and the digesters. I did not feel at liberty to make an experiment which would involve so very serious a risk as that would have done.

X Q. 104. Did Mr. Gamble tell you that he thought it would be dangerous to use a higher pressure than 130 pounds or thereabouts?

A. He did not; but in the course of conversation he told me in substance what I have just repeated, namely, he did not feel easy to have the apparatus used at the high pressures they had run at before, and I gathered that this was the main motive in using lower pressures.

X Q. 105. Do you not know that up to within a month of
1458 the time you made your experiments those same digesters had been run at very much higher pressures?

A. I have absolutely no knowledge on the subject.

X Q. 106. Mr. Gamble did not tell you, then, that the use of such a pressure as you experimented with had only been commenced in his works within a week or two of your visit to Cincinnati?

A. I have no recollection of any such statement.

X Q. 107. When did your conversation with Mr. Gamble on this subject take place?

A. I think it was on the day when we were running the Tilghman coil apparatus, and it was in the course of a general conversation. That was May 11th.

X Q. 108. Then he did not mention the danger to you until after you had made the experiment?

A. Yes; that is true.

X Q. 109. Then how can that be a reason for your not using a higher pressure when you did make the experiment?

A. I did not intend it in that sense. I intended it as a reason why I did not also make the experiment at a higher pressure. Under any circumstances I should have made an experiment at the

pressure which was used in the factory when I came there, and I had thought of using higher pressures, but gave up the idea after this conversation with Mr. Gamble.

X Q. 110. You have absolutely no data, then, which will enable you to state what the comparative efficiency of the treatment with lime and the treatment without lime would be at a pressure of from 200 to 250 pounds?

A. I have none.

X Q. 111. So far as your experiments did go you found, did you not, that the difference in efficiency of these two treatments diminished as the pressure increased?

1459 A. Not in proportion as the pressure increased, but with an increased pressure the difference was less.

X Q. 112. In answer to question 25 you stated on page 272 of the master's record that the experiment made by Messrs. Procter & Gamble at your request, in which they used no lime without change of water, gave 88.85 per cent. of free fatty acid——

A. Allow me to interrupt you here to state that I do not understand the passage in question to assert that the experiment to which you refer was made by Procter & Gamble at my request, but only that the first one mentioned in that connection—the one with lime—was so made, the second being in fact the experiment which I myself made at the works of Procter & Gamble on May 11th, and which is described near the top of page 267.

X Q. 113. I am unable to reconcile your explanation with the statement which you made yesterday and which I quote: "I also tested recently the material sent me by Mr. Gamble, which was prepared by him by heating fat and water without lime in one of his large digesters referred to by me near the top of page 272. This product (being also noticeably rancid) on retesting recently showed 92.46 fat acid instead of 88.81, as determined by Dr. Endemann and reported by him to me." Both in your testimony on pages 271 and 272 and in this reference to it which you made yesterday it seems to me that you speak of the experiment without lime as having been made by Mr. Gamble.

A. In the first place, as regards yesterday's testimony, the reference which I made was done at your own request while I was describing the various comparisons of tests made by Dr. Endemann and myself, and when I had not prepared myself to give references to the pages of the record where any of them were found.

1460 In doing this hastily, my attention being directed to this particular page by some one who was present, I was led to think that this was the material about which I was speaking. Last evening, however, in preparing the table of tests for the convenience of reference of all concerned, I noticed this error, and when I came here this morning pointed it out to you and received your permission, as I understood, to make this correction, though in making it on the record I inadvertently failed to strike out this reference to a page which, if left in, makes the rest of the correction absurd and useless. If the words "referred to by me, near the top of page 272," be omitted it is hardly necessary to say that your

last question, so far as this matter is concerned, will have no object. As far as the passage in my previous testimony on pages 271 and 272 is concerned, I think there is no difficulty whatever in understanding them, if the effort is made. I say there "another experiment," not "other experiments," made by Messrs. Procter & Gamble developed the same thing." Now, this experiment could only develop something which was a relation by being combined with some other experiment. This first experiment, made by Procter & Gamble, at my request, with water and lime and fat, is then related and its result given; and then I proceeded to state that the same amount of material heated for the same time under the same pressure, without change of water, "gave 88.85 per cent. of free fat acid, as I have already described." Now, that description already given is found on pages 266 and 267, and consists in a relation of the experiment carried out at the works of Messrs. Procter & Gamble by myself on the 10th of May, in which by the use of fat, water, and lime, but without change of water, a product showing the composition of 88.85 per cent. fat acid was obtained.

(Mr. Chambers states that Dr. Morton, having stated to
1461 him before the beginning of his deposition of to-day that there were some errors which he desired to correct in his testimony of yesterday, he told him that he would have no objection to his making any correction that he pleased and desired him to make such corrections on the record, which Dr. Morton proceeded to do, and he further states that he has no recollection of Dr. Morton having specifically called his attention to what now appears to have been an error in the reference to a certain page of the printed record.

The witness states: I can only state that I did my best to make Mr. Chambers understand the full nature of error and correction, which I proposed to make, and that I supposed that the correction had been made, or would have been careful to have made it, before going on with the testimony.)

X Q. 114. Is the table which you have now prepared and put in evidence absolutely correct?

A. I believe it to be so.

X Q. 115. Does the statement, which you make on page 272, to the effect that "a product heated for nine hours with one per cent. of lime and a change in the water showed 97.5 per cent. of free fatty acid," refer to the charge made by yourself or that made by Mr. Gamble and sent to you?

A. This refers to the product made by Mr. Gamble and sent to me.

X Q. 116. And where, in the same paragraph, you say, "The same amount of material heated for the same time, under the same pressure, without change of water, gave 88.85 per cent. of free fatty acid," you refer to the experiment made by yourself in Cincinnati?

A. I do.

1462 X 117. Q. Then, in your former deposition, as printed on page 272, you coupled together an experiment made with lime by Mr. Gamble and one made with lime by yourself?

A. I did not. I coupled together an experiment made by Mr. Gamble with lime and a change of water with an experiment made by me with lime and no change of water. This will be manifest, if you will refer to the description of the experiment in question, beginning with the sentence at the fourth line from the foot of page 266, as follows: "The quantity of water in this case was 3,850 pounds. To this there was added 70 pounds of dry lime, previously slacked. This was heated to the same temperature and pressure, exactly as the other cylinder, for nine hours; in fact, the steam-pipe which supplied the two cylinders branched and opened into both of them, and a pumping apparatus precisely like that used in the other cylinder was kept in continual motion, which served to mix the fat and water. At the end of nine hours from the time of starting I took from this tank a specimen of the oily product, which I had analyzed with Dr. Endemann at the medical college at the same time with the other samples, and found that it contained 88.85 per cent. of free fat acid."

X Q. 118. As I now understand it, Mr. Gamble made, at your request, two experiments, one with and the other without lime, sent you samples of the product of both, which samples were both analyzed. Is that right?

A. Nearly. Mr. Gamble made, in all, three experiments at my request, and sent me three samples, all of which were analyzed, but only one of the analyses was stated in the earlier parts of the testimony, I believe, so far as my examination and study of the testimony has gone, either by Dr. Endemann or myself.

1463 X Q. 119. What were those three experiments, and when, or about when, were they made?

A. I have not the dates here, but think I recollect them. One, I think, was made on the 11th, one on the 17th, and one on the 19th of April. Two of them consisted in heating lime, water, and fat, and one of them was made without lime. To the best of my recollection, one of them was heated for nine hours, in two others it was about eleven hours—one of the two heated for about eleven hours being with water and one with lime; and there being two with lime, one heated for about 9 hours and one for about eleven. That is the best of my recollection of the experiments, but I may be in error as to some detail.

X Q. 120. What pressure was used with these experiments?

A. One hundred and fifty pounds, in all cases, as indicated by the same gauge as we afterward used. Of course, I can say nothing as to that.

If you wish, I will by our next meeting prepare for you a full statement of all the details in regard to these three experiments that I can give you, from Mr. Gamble's letters and from my labaratory book.

X Q. 121. The sample which was made without the use of lime was at that time subjected to three analyses, as I understand you—one by Dr. Endemann and two by yourself?

A. That is correct.

X Q. 122. And these two analyses, as I understand, were the only two analyses that you personally made prior to going to Cincinnati?

A. That is also true with the exception, of course, of what may be called trial analyses, of which I made a number to familiarize myself with the operation of this special test.

X Q. 123. You made no test at that time of the sample
1464 prepared with lime, and which Dr. Endemann's analysis showed to contain 97.5 per cent. of fatty acid?

A. I did not.

X Q. 124. When you afterward analysed this same sample, you got as the result of three different analyses 94.3, 94.4, and 94.9 of the fatty acid in the product?

A. I did.

X Q. 125. And when you afterward and at about the same time analysed the sample prepared with water alone, you got 92.46 per cent. of fatty acid?

A. I did not.

X Q. 126. What, then, is the meaning of your statement contained in your deposition of yesterday and to the following effect: "I also tested recently the material sent me by Mr. Gamble, which was prepared by him by heating fat and water without lime in one of his large digesters. * * * This product (being also noticeably rancid), on retesting recently, gave 92.46 of fat acid instead of 88.81, as determined by Dr. Endemann and reported by him to me?"

A. It means that when recently I repeated that test, I got the results I there state; but it does not mean that I got those results when I made the test at about the same time that Dr. Endemann made his, which is what your question asserted.

X Q. 127. You have misunderstood my former question, which I now repeat. (Q. 124 and 125 read to witness.)

A. As I made two analyses and so described *it* at great length, one of them shortly after Dr. Endemann made his, and the other later, I think I very naturally understood your question to refer to these two and answered it with that understanding.

X Q. 128. Now, please answer with the corrected understanding.

A. With the explanation you have made, I understand
1465 that you refer only to the last analysis which I made of this sample, and that analysis you have correctly stated. Two others, made nearly at the same time with Dr. Endemann's, showed 90.1 and 90.6.

X Q. 129. The fact, then, is, is it not, that the two tests which you made recently, and I understand at nearly the same time, showed the product with lime to contain 94.3 to 94.9 fatty acid and the product without lime to contain 92.46 fatty acid?

A. That is correct.

X Q. 130. You have explained in your deposition of yesterday that you think the fact that you found more fatty acid in the product made without lime now than you did formerly may be owing to the formation of more fatty acids by reason of the fats in the mixture growing rancid. Would not the fats in the product obtained with lime also have a tendency to become rancid and induce fatty

acids in the product, supposing that you were right in assuming such an action to take place?

A. Undoubtedly, but not at all to the same degree, for two reasons: In the first place, the product prepared with lime contained less neutral fat to become rancid; and, in the second place, the presence of the lime would undoubtedly act as a restraint to decomposition by taking up some of the products and thus checking its progress. The product obtained by water alone would have in it a larger amount, as I have already said, of neutral fat to be decomposed or become rancid, and would also be likely to contain more nitrogenous substance such as causes this decomposition, which would have been destroyed by the action of the lime during the heating of the other.

X Q. 131. What authority have you for the statement you make as to the supposed action of the lime?

A. I cannot refer at this moment to any specific authority, but it is well known in the science of chemistry that the presence of
1466 alkali tends to check fermentation of all sorts, and also many chemical decompositions—thus, for example, the material celluloid, if manufactured without any alkali, is liable to spontaneous decomposition, which is, however, entirely checked by the presence of a small portion of any alkaline base.

X Q. 132. Is there any alkali present in a product made by treating fats with water under pressure and one per cent. of lime?

A. There is, in the sense that there is lime there present in comparatively weak combination with stearic or other fatty acid; therefore, in the presence of any stronger acid capable of decomposing that compound, the alkali is effectively and practically present and active as such just as though it were free.

X Q. 133. As you have stated that it is well known that the presence of lime or lime soap has a tendency to prevent rancidity in neutral fats, please produce such authority as you can find on this point at the meeting on Tuesday next.

A. I have not stated that it is well known that lime or lime soap tends to prevent rancidity, but I have stated that it is well known that alkalies tend to check such actions as rancidity. If, however, I have time to look the matter up, which, as I am going out of town on Monday, there is very little chance I should have, I will do my best to supply you with any authority I can secure bearing upon the subject, and I will do so equally whether what I find supports or corrects my general impression.

X Q. 134. Do I understand you as admitting that there would be a tendency toward rancidity, and consequent increase of fatty acid, as you think, in the material which contained the one per cent. of lime, although less, for the reasons you have stated, than any material which does not contain any lime, or do you mean that, in your opinion, there would be no tendency toward rancidity at all?

1467 A. I think I have already stated very clearly that there would be a tendency to rancidity even in the material containing lime, but that it would be less than any material not containing it, not only on account of the presence of lime, but on ac-

count of the absence of nitrogenous matters which the lime would have aided in destroying.

X Q. 135. And yet, in spite of your opinion that the subsequent analysis should have shown more fat acid present in this product than the earlier analysis, your actual tests in two instances showed less fat acid to the extent of more than three per cent.?

A. I cannot accept your first statement as being in any way my conclusion or reason, because I do not account for the discrepancy between Dr. Endemann's result and mine in this case on any such theory. I am, in fact, quite unable to frame any theory to explain this discrepancy. All I can say about it is that it is one of those discrepancies which will occasionally occur between the work of different people at different times where the process used is capable of being influenced in its results to a certain extent by surrounding circumstances.

X Q. 136. Yesterday you framed the following theory to account for this discrepancy: This you said: "I do not consider [it] to be anything more than such a variation as might fairly occur in the work of two experimenters, employing a test of this nature, where absolute certainty of result within a per cent. or two is not to be looked for, and where close comparisons can only be made between tests conducted by the same experimenter under essentially identical conditions." Have you changed your mind as to whether this theory satisfactorily accounts for the difference?

A. I have not changed my mind, and I had that very explanation in mind when I made my answer just now, which explanation, however, I should not call a theory accounting for these differ-
1468 ences in results. By a theory accounting for such difference I should understand some probable system of causes like that which I think so well explains most or all of the other differences between Dr. Endemann's results and mine. The statement that the difference in this particular case is one which might occur as above explained is, in my mind, a totally different thing from a theory explaining its existence.

X Q. 137. When did you commence to correspond with Mess. Procter & Gamble about this case?

A. In the early part of this year; but I do not like to attempt giving the date from memory. I received a letter from Mr. Parkinson asking me if I were free to give him services in connection with this subject. The first communication that I recollect from Mr. Gamble was his letter accompanying the first of the samples he sent me. I have had no correspondence whatever with any one else connected with that company.

X Q. 138. Were the experiments made by Mr. Gamble made on your suggestion?

A. They were.

X Q. 139. Was the pressure to be used suggested by you?

A. No; I asked him to make experiments at the pressure he was using, about which I knew nothing at that time.

X Q. 140. When did you make this request?

A. I think a week or two before he sent me the first sample.

X Q. 141. Which was quite early in April?

A. April 11th or 12th.

X Q. 142. Can you fix the date of your letter containing this request?

A. I have no means of fixing the date. I am not in the practice of making copies of my letters, unless they involve something which I regard of very unusual importance, but did not consider this to be.

1469 (Mr. Parkinson stated that he will have enquiry made for the correspondence, and if he finds any means of ascertaining the date will have it furnished to the counsel for complainant; that he is, personally, at present, unaware to whom the letter was addressed or whether it is in existence.)

X Q. 143. Were you aware, when you received these samples, that they were all made at a pressure of less, by fifty pounds, than was then being used in the factory in the ordinary process of manufacturing fatty acids?

A. I was not.

X Q. 144. When you received these samples and the letter accompanying them, did it contain any statement that they had been made at the usual pressure in use at the factory?

A. I do not like to state the contents of a letter, which I have got, from a mere general recollection of it; but the impression produced in my mind was that these were produced at the pressure used in the factory.

X Q. 145. Have you any objection to produce them?

A. I have already promised to give you the contents of them.

X Q. 146. You stated in your deposition in Cincinnati, Master's Record, page 260, in reference to the product obtained by distillation, that "the entire product of fatty matter was fused together and then tested, and found to consist of an essentially pure fatty acid—that is to say, it showed fully 99 per cent. of free fat acid." I understand you now to state that this material was not tested, and that no analysis was made, either by you or by Dr. Endemann, which determined that 99 per cent. of free fatty acid existed in the product. Am I entirely correct?

1470 A. I do not recollect that I made any such statement, but, as a matter of fact, it is true that my statement, in the testimony to which you have referred, was given simply on the authority of Dr. Endemann, who personally reported that result to me; in other words, told me that he had got that result, and I also heard him testify to the same, and have since heard him state that, in some unaccountable way, he had got it in his mind that he had made the test with such a result, when, as a matter of fact, he had not done so. I was not prepared at that time to assert, as of my own knowledge, that Dr. Endemann had made the test, nor am I prepared now, as of my own knowledge, as your question would imply, to assert that he did not. It is on his own authority that either of the statements must stand.

X Q. 147. Is there anything in your answer to question 11, from

which I have quoted the passage referred to, which would lead any one to suppose that you were therein stating facts which somebody else had told you, and which were not within your knowledge, and for which you could not be personally responsible?

A. I find no such qualification, and though I did not intend to claim personal knowledge, yet I felt so well satisfied of the fact at the time that it was not unnatural for me to speak of it without stopping to qualify my statement in the way that I should have done if my attention had been drawn to the subject in any way.

X Q. 148. In the following question, No. 12, I did call, or try to call, your attention to this subject. Is there anything in the answer to that question which would lead any one to suppose that you had not taken a personal share in the work spoken of?

A. I do not at all agree with you in your statement that your question No. 12 in any way tended to draw my attention to
1471 the fact of the analysis having been my own work or not. On the contrary, it directed my attention to the operation of distillation, and, as it was true, as a matter of fact, that I had taken a full share in that operation, I think the answer is entirely proper and candid in all that it states, even to the extent of showing that I had not regarded the experiment as one requiring close attention to quantities and the like, but had been satisfied with obtaining from it simply general information. Had you asked me whether the analysis had been made by me I should not have hesitated a moment in stating that it was not, but was made by Dr. Endemann.

X Q. 149. You stated in your answer to question 12 as follows: "These quantities and weights were, of course, determined subsequently to the time of making the experiment, as the water containing the glycerine had to be evaporated and the fatty acids collected and melted." Now, as a matter of fact, these quantities and weights were never determined at all by anybody, were they?

A. As I stated in the sentence immediately preceding that which you have quoted from, "The amounts were small, and I do not know whether I weighed the quantity or not," this referring, of course, to the quantity of fat acid and glycerine and residue. When I returned to Hoboken I found, however, that the glycerine had been preserved, and I then weighed it, and will produce it at our next meeting. The residue and a portion of the fatty-acid product was also preserved, and I can furnish you with that, I think, also. A portion of the product and residue were taken by or taken to Dr. Endemann, and that, I believe, has been used up or was used up by him. This experiment, however, as I have already stated, having been conducted without any idea of obtaining quantitive results, I have concerned myself very little about it, since I made the other experiments about which I testified yesterday, which were made
1472 with the idea of obtaining quantitive results in view, and which furnish, as I believe, all the information that I could obtain on the subject with the means at my command.

(Answer objected to as irresponsive, and question repeated.)

X Q. 150. (X Q. 149 read to witness.)

A. I am not prepared to answer that question fully and definitely now, because I am not sure whether the amount of the residue and the amount of the fat acid were not determined roughly at the time that the experiment was made; and as for the glycerine, I know that has been determined, for I did it myself.

X Q. 151. My question was as to whether you were correct in making the statement you made at the time when you made it and in the connection with which you made it. Do I understand that you had, prior to the time when you so answered, made this de[ter]-mination of glycerine?

A. I had not, and I fully admit that the passage, as read, does not correctly convey the idea that was in my mind when I made the statement, which I think is, however, manifest from the entire answer, the idea not being to assert positively that the weights have been determined, but merely to indicate that, if determined, this was done subsequent to the time of making the experiment, and, therefore, was liable to have been overlooked. This appears if the passage which you omit in quoting the question, or at least which you fail to quote in connection with its immediate context, is read with it, namely, "The amounts were small, and I do not know whether I weighed the quantity or not." After this it seems to me tolerably clear that the following paragraph was not intended as a contradictory assertion to that which had immediately preceded it, but was only a colloquial way of saying what I have just explained.

1473 X Q. 152. The fact being, as shown by your subsequent experiments, that 88 per cent. of fatty acid in the distillate was the very highest and best product that could be obtained by this distillation process, how was it possible for Dr. Endemann and yourself to state positively, as you both did state, that in this first experiment you obtained a distillate containing 99 per cent. or more of free fatty acid?

A. How Dr. Endemann came to make the mistake he did I am quite unable to explain; but that mistake having been made by him, it would seem to me rather difficult to show how I could have avoided, under the circumstances, being misled, and repeating it. As I have already shown, there are abundant authorities of a high character which assert that a complete and perfect decomposition, even to the last atom, of a neutral fat into fat acid and glycerine is effected by the very process we had worked, and, therefore, there was nothing to occasion in my mind the slightest doubt that Dr. Endemann was correct when he told me that our product was a pure fat acid. The authors to whom I refer are, among others, Payen, who asserts that the last portions of neutral fat which had resisted the most violent treatment with strong sulphuric acid were decomposed by the action of superheated steam; Morfit, who states the same thing, and Allen, who not only makes the statement in words, but gives a chemical formula, showing the complete decomposition of neutral fat into fat acid and glycerine by the action of steam. In fact, notwithstanding my failure on a small scale and with this little apparatus, where, under the most favorable circumstances, the fat is only subjected to the action of the steam for a fraction of a second—

notwithstanding, I say, my failure to obtain a better result than a product still retaining 12 per cent. of undecomposed fat—I am still
1474 strongly of opinion that, under more favorable conditions, this decomposition might be effected to the complete degree which is stated in the works of the authors I have referred to, as well as by others.

Adjourned to Tuesday, July 3rd, 1883, at 10.30 a. m.

Cross-examination of HENRY MORTON continued.

By Mr. CHAMBERS:

The witness stated that since the last meeting he has found the letters received from Mr. Gamble, and has made a transcript of them, which he now presents, and has added to those, as he promised, a statement as to the labels on the bottles containing the samples accompanying these letters, and results of analyses made of said samples, and also produces the original letters for comparison with the transcript.

(The said transcript is put in evidence and marked "Defendants' Exhibit Gamble Letters." By consent of counsel it is to be used instead of the original letters.)

WITNESS: In connection with this, I desire to refer to my answer to question 86, where I said, "Another similar pair is found in the two experiments made by Dr. Endemann and I in the large digester at the works of Messrs. Procter & Gamble, and a third in the pair of experiments made at my request by Mr. Gamble." As these letters show, these experiments made by Mr. Gamble were not identical in the time during which the materials were exposed to
1475 heat and pressure; but, for the purpose in view, this really made no difference, since the experiment shows that a mixture of fat and water without lime, even though heated for fourteen hours, was very much less thoroughly saponified than a similar mixture containing one per cent. of lime heated under identical conditions for 8½ hours, and therefore simply makes the argument yet stronger that had they been heated for equal times the failure to obtain saponification where the lime is absent would have been still more marked.

And, in this connection also, I would desire to correct my answer to question 118, in which I stated that all the samples received from Mr. Gamble had been analyzed, which was my impression at the time, but since I referred to the letters I recall that the first of these samples had not been analyzed for the reason that it did not express any result, which I then regarded as important, since the time for which the sample was exposed was greater than that used in the factory, and yet did not correspond with the time of exposure of any other samples.

Also, in my answer to question 119, I stated, referring to the samples above mentioned, "To the best of my recollection, one of them was heated for nine hours, in two others it was about eleven hours, one of the two heated for about eleven hours being with water and

one with lime." On examining these letters I find, as the letters themselves of course show, that none of them were heated for exactly nine hours, as stated in my testimony; but the one to which I referred as being heated for nine hours was, as stated in the letter, heated for 8½ hours. The reason for this discrepancy comes from the fact that the time stated in the letter excludes the time during which the glycerine water was drawn off and fresh water was run in to replace it. This would occupy half an hour; and, in thinking of this experiment, I had in my mind the entire time. This
1476 difference of a half an hour I do not regard as having any influence in reference to any deduction or any conclusion which I have drawn from that experiment; and whatever influence that difference of time would have would merely strengthen the conclusions, because it would show that the effect referred to was obtained in even a shorter time than stated by half an hour.

In reference to the two other experiments which on Saturday my general recollection led me to think were each made in eleven hours, I find that one was made in eleven hours, but that the other occupied eleven and a half hours with the first water and three with the second water, making in all 14½ hours, from which, however, should be deducted half an hour for the change of water. To the best of my recollection, at present, I have made no deductions regarding the experiment in which the question of time comes in, and, therefore, as far as I am aware, there is nothing requiring correction; if I am in error as to that it will be time enough to explain what bearing this has on any point when it comes up.

In my answer to question 149 I state: "When I returned to Hoboken I found, however, that the glycerine had been preserved, and I then weighed it, and will produce it at our next meeting. The residue in a portion of the fatty acid product was also preserved and I can furnish you with that, I think, also." The weight of the glycerine was one and one-third grammes; the product of distillation, which was received in the flask into which, as I have mentioned in my early testimony, the vapor from the stil lfirst passed, was put into a bottle and labeled, but not weighed until recently, when I found its weight to be 17 grammes; the portion which was collected in the Liebig's condenser, into which the vapor not condensed in the flask passed, as I mentioned in my original testimony, I think, was also bottled, but was weighed at the time; and,
1477 though this was partly used up the label on the bottle shows the weight to have been 19.3 grammes, making the entire fatty product distilled over 36.3 grammes. This was the second of the two original distillation experiments, and the only one of which I took any note, considering the other to have been simply an unsuccessful preliminary trial for the reasons I have before fully stated. The amount of fat taken was 150 grammes. The residue left in the still was not weighed or preserved.

The glycerine and the portion of the distilled acid, to which I have above referred, I intended to have brought over with me this morning, but forgot to do so in hurrying off, but will bring them, if you desire them, to-morrow.

In my answer to question 130 I state: "In the second place the presence of lime would, undoubtedly, act as a restraint to decomposition by taking up some of the products and thus checking its progress." In question 131 I was asked what authority I had as to the supposed action of the lime, in answer to which I stated that it was well known in the science of chemistry that the presence of alkali tends to check fermentation of all sorts. In question 133 I am again asked for authorities and stated that I will furnish such as I had time to look up. Though my time has been very limited I find, in Johnson's Encyclopedia, published in New York in 1878, edited by President Barnard, of Columbia College, volume I, page 1361, the statement that earth, lime, and charcoal act as disinfectants by absorbing injurious substances, and a similar statement, I have no doubt, will be found in many other places, the absorbing power of lime being the chief reason for its use as a disinfectant, which, as is well known, is quite extensive, and the coupling of lime with earth and charcoal (two of the most conspicuous absorbents) in the
1478 authority referred to makes the statement a very strong one in favor of the opinion I have stated. The quotation is as follows: "The modes of action of the above-named disinfectant substances may be classified as follows: 1. By absorbing gases and preventing their emanation—dry earth, lime, charcoal."

X Q. 153. You have given the quantities of fatty material distilled over in the second distillation experiment. Please state what per cent. the distillate was of the fats treated.

A. 24.2 per cent.

X Q. 154. Then Dr. Endemann overstated the amount about one hundred per cent. when he stated that this distillate amounted to about fifty per cent. of the fats treated?

A. I don't recollect that Dr. Endemann made any positive statement. My impression was that he said he only thought it was, or supposed it was, not having made any determination, but if he said it was fifty per cent. he was of course in error.

X Q. 155. It also was an error, was it not, when he stated that no account was taken of the amount distilled?

A. No; because that was quite true. One portion of it was put in a bottle, and not weighed until recently; another portion was put in another bottle and weighed, but possibly not by Dr. Endemann. No account was taken at the time.

X Q. 156. Do you not think that the fact that, in describing the second distillation experiment, Dr. Endemann, after stating that the first distillation experiment showed 99 per cent. of pure fat acids in the distillate, and pure fat acid in the distillate of the second experiment, and that you stated that the distillate of the second experiment showed 99 per cent. of free fat acids, would lead any one to suppose that you had made an independent analysis of this product differing by one per cent. from Dr. Endemann's analysis?

1479 A. It might do so. My understanding from Dr. Endemann was that the 99 per cent. was the result shown by analysing in the product of the second distillation, and I had no idea, as far as I can recollect, as to the exact percentage in the first product, if

I even knew at that time that it had been analysed, but of this I cannot say, as I have not an entirely clear recollection at present. All I do recollect positively is that it was the second experiment which I regarded as the one yielding 99 per cent.

X Q. 157. You state, in answer to cross-question 120, that the pressure of 150 pounds indicated by the guage in the experiments made by Mr. Gamble, at your request, was by the same guage that you afterward used in Cincinnati. You do not know this to be the fact, do you?

A. I think I have so stated in the answer referred to, which concludes with the words: "Of course, I can say nothing as to that"—meaning by this to imply that I supposed it was, but did not know.

X Q. 158. Since Mr. Gamble stated, in answer to question 9, Master's Record, page 225, that this was not the same gauge that you afterward used, I suppose you are willing to admit you are mistaken in your supposition?

A. Certainly I am.

X Q. 159. Let me call your attention to that portion of your answer to question 55 (incorrectly printed, should be 54) embodied in the first line of page 298 of the Master's Record, where you speak in regard to your distillation experiment, "in my case the fat acid was absolutely pure." This is one of the conclusions which you have withdrawn, as stated by you, after your later experiments with distillation?

A. It is.

X Q. 160. Why have you not made an analysis of the distillate of your first distillation experiment, in regard to which so many erroneous statements have been made?

1480 A. I have made an analysis of it, but have not reported it, because I considered that experiment as entirely discarded and replaced by the several experiments which I described in my answer to the first question that was asked me on the reopening of my testimony here, to wit, question 57.

X Q. 161. Please give this analysis.

A. I made two, giving the results 77 and 78 per cent. of free fat acid.

X Q. 162. I suppose, of course, the product was rancid, as in the case of the other mixtures you have spoken of that had been kept about the same time?

A. My impression is that it was not, but I have the product, and we will settle that to-morrow.

X Q. 163. Let us, for purposes of comparison, have the other products of which you have spoken also.

A. I will bring them.

X Q. 164. Did you also make an analysis of the residue left in the still after the first experiment?

A. I did not.

X Q. 165. You have, in describing your distillation experiments, spoken of the glycerine in some, if not all, instances as being a corresponding amount to the fatty acids obtained, and in some instances

you have given the weight of the glycerine obtained in the experiment. How did you obtain these weights?

A. In the first place, I think that where I have spoken of the glycerine as corresponding in amount to the fatty acids obtained it was where I had not weighed them both, and therefore the correspondence was only claimed to be one, such as would result from a conjecture. It is, however, true that, comparing the amount of glycerine obtained in these small experiments with amounts obtained in corresponding experiments made by digesting fat with water, with or without lime, where there would be no theoretical loss of glycerine, the proportions obtained by distillation were as great in
1481 proportion to the fat acted upon or decomposed as in the process in the digester, which indicated that the smallness of the amount, which is manifest where weighings are made and is shown in the results of said weighings, which I have given, came from the losses incident to working upon so small a scale, and therefore I think that it would not be incorrect to assume that even these small amounts corresponded in the case of the distillation with the amount of fatty acid obtained under the conditions of the experiment.

The second part of your question asks how weighings were made. The watery liquids containing glycerine were evaporated at first in large evaporating dishes, and as they became concentrated were transferred to smaller ones, which had been previously weighed, and when the concentration had been carried as far as it seemed safe to push it, because glycerine itself evaporates during concentration, the entire weight was taken and the weight of the dish subtracted. In a few cases where the glycerine, after concentration, had been preserved in a bottle before weighing, as in the glycerine left from my first distillation experiment, the weight of the bottle and all was taken, then the glycerine allowed to run out into another bottle, and, the empty bottle being weighed, the difference between these weights gave the weight of the glycerine. Although this showed a weight a little too light, I considered it sufficiently near the truth and as the best result I could obtain without loss of the glycerine.

X Q. 166. In the experiments which you made in your little digesters did you save and evaporate the glycerine down?

A. I did, and in my testimony, near the end of the answer to question 65, have given the quantity in one case.

X Q. 167. You stated in answer to question 65 that the
1482 glycerine from the digesters was concentrated to the same point as that obtained from the distillation experiment mentioned there. How do you know this?

A. By the equal viscosity or molasses-like consistency of the two samples.

X Q. 168. How did you measure this viscosity?

A. By observing the manner in which they flowed in the bottles which contained them, or in the vessel.

X Q. 169. Do chemists in general determine the contents of different solutions by the method you have described as being used by you?

A. It depends upon circumstances. If it is important to obtain a very precise result, and the amount of material admits of it, various other and exact methods are used; but where the object is simply a general or rough comparison, and where the amounts to be used are very small and it is important that none should be lost, I think any chemist would follow the same plan that I have done in this case.

The materials, I think, are still in existence, and, if you desire it, I will apply the most accurate method that I can think of to determine the precise density as well as weight of these samples.

X Q. 170. Your statement in answer to Q. 65, to which I have referred, is a very positive statement. You say "the glycerines were concentrated to the same point," and in referring to the glycerine derived from the distillation experiment made by you and Dr. Endemann you say, in answer to Q. 55, "I obtained, I am sure, the full proportion of glycerine which should have come over with the amount of fat acid obtained." In this last case, the fact being that you were sure you had at the time obtained a pure fat acid, and the fact being that it was considerably below 80 per cent. fat acid, it is obviously impossible that you should have obtained a corresponding amount of glycerine. In other instances, also, you have
1483 excused positive assertions of fact on subjects which you now admit you had not investigated by the plea that you did not consider them of much importance. I wish you would examine your testimony and point out which of your positive assertions throughout are to be qualified by this mental reservation of want of importance. Will you do this at our next meeting, or as soon as you have had the time?

(Objected to as misrepresenting the testimony of the witness.)

A. As your question contains a great many separate subjects, I will discuss it by sections.

In the first place, when I asserted that the glycerines were concentrated to the same point, I felt as confident, and still feel as confident, that this is so as the form of assertion would imply.

In the second place, the second part of your question refers to my answer to question 55, where I said "there was no acroleine, and I obtained, I am sure, the full proportion of glycerine which should have come over with the amount of fat acid obtained. My assur*ed* in this case was founded upon the absence of acroleine, as well as upon the apparent yield of glycerine, and was, I think, warranted by these combined observations.

In reference to the third portion of your question, you assert that I have excused erroneous positive assertions on the ground that I did not consider the matter of importance. I am quite unaware of having made any such statements, but have explained the absence of careful experiment and the notation of results as being caused by my considering the matters involved unimportant. If you will point out to me any reference which you think sustains your statement, I think I can readily show that you are laboring under
1484 some misapprehension as to the meaning of the passage in question.

X Q. 171. In your answer to question 55, in that portion of it printed at the top of page 298, you state, as to the first distillation experiment, that the fat acid was absolutely pure; that you obtained, you were sure, the full proportion of glycerine which should have come over with the amount of fat acid obtained. Do I understand you to justify this statement in spite of the facts which you have admitted, that when you made it you did not know the quantity of the distillate, the amount of fat acids contained in it, or the amount of the glycerine obtained by the experiment?

A. Only to the extent that, as I have said, my confidence as to the result was warranted by what I believed to be the facts. That one of these facts was determined by some one else, and that the two others were obtained, not by weighing, but by estimating, of course, greatly diminishes the solidity of my foundation. But, as far as I was myself concerned, I think I was authorized in feeling confident as to the statement I then made, in view of its *a priori* probability and the seeming coincidence of two independent confirmatory witnesses, the absence of acroleine and the asserted purity of the acid. If the acid was pure all the glycerine must have been there, unless acroleine had been formed; there being no formation of acroleine, it would, of course, logically follow that all the glycerine was there; and besides this, in appearance, all the glycerine was there, as I then thought.

X Q. 172. Do you not think it would be better, in framing your answers, to distinguish between those opinions you form from facts which are stated to you by others, or which you infer to exist, and those which are formed from facts of which you personally have knowledge, and as to which alone it is competent for you to testify?

1485 A. If it were always possible to do so it would probably be better to make such a distinction as you indicate between conclusions formed on my own individual experience solely and those which result from a combination of my own observation with those of others. But, as in the mental operation by which we reach conclusions, it is, I think, extremely difficult, if not impossible, entirely to separate our own conclusions, founded solely on our own observations, from those in which information otherwise obtained is also involved, I do not know that it would be possible to carry out effectively the distinction you suggest.

X Q. 173. To commence with, then you [do] not know the quantity of dry glycerine contained in any one of your experiments, do you?

A. I do not.

X Q. 174. Will you prepare a statement, in tabular form, showing the number of distillation experiments made by you, giving the date of experiment, the time of distillation, heat employed (steam, fat, and bath), percentage of fat distilled, percentage of fat acid contained in distillate, quantity of steam condensed, quantity of dry glycerine in distillate, and date of analysis?

A. I will.

X Q. 175. You have described the method of analysis used by you

in determining the amount of fatty acids in different products analysed by you. Please state when you first used this method.

A. I first used this in making the analysis of the product sent me by Mr. Gamble, which was prepared by heating fat and water without lime. This analysis was made about May 8th of this year. I had, however, before this experimented with it on known mixtures so as to become familiar with its proper operation. This experimental work was done several weeks prior to this time.

X Q. 176. What method of analysis did you use before this time for determining the quantity of fatty products?

1486 A. I never had any occasion to make this determination before.

X Q. 177. You have stated it as your opinion that the method of analysis used by Professor Booth, and other chemists in this case, was less accurate than the method employed by yourself. Did you reach this conclusion by *a priori* reasoning; or did you institute a test of the two methods of analyses to find out what, if any, difference there was between them?

A. In the first instance, I reached this conclusion by what may be called *a priori* reasoning, founded upon experience in analogous cases; but I afterward confirmed my conclusions, as I have stated in my testimony, by making an analysis by both methods of the same substance with the results there stated, and in this experiment it appeared that a substance which was shown to contain 30 per cent. of neutral fat by the process I used only showed 4.4 per cent. by the analysis with alcohol, carried out in the manner recommended by one of the most recent authorities, J. Post, whose work is one of the most recent books on technical analysis.

X Q. 178. The answer to question 68 details a subsequent test made by you, where, by diluting the alcohol, you obtained, comparatively speaking, very much more accurate results than you did in the first experiment or test. Did you follow this up to see how accurate the method might become by further distillation?

A. I did; I made another experiment, using an alcohol containing 70 per cent. of true alcohol by volume, which is the alcohol mentioned in Professor Booth's testimony as being used by him, and the result on the same material was 15 per cent., which is only a hundred per cent. out, but is, nevertheless, better than what you describe as the "much better" result obtained. In fact, by varying the strength of the alcohol, the quantities taken, the temperatures employed, and so on, I have not the slightest doubt that

1487 out of a given specimen of fat acids and neutral fat products it would be possible to obtain almost any result that one pleased.

X Q. 179. Are we to understand that you do not think Professor Booth was justified in using the method of analysis used by him?

A. By no means; I have not the slightest intention of criticising Professor Booth in any such way as that, since I regard him with great respect, but I consider that the science of chemistry in this connection has made great advances within the last few years, and that, while at the time Professor Booth made these experiments no

better way was perhaps known than that which he used, yet, at the present time, a very much better way is known, and that this better way shows that the results obtained by the older method are quite unreliable.

As to the fact that this method used by me is a highly approved method, I would cite from the transactions of the German Chemical Society, or, to give it its German title, "Berichte der Deutschen Chemischen Gesellschaft," two articles, by Karl Zulkossky, entitled "Contribution to the testing of fats," which appear in No. 8, May 21st, 1883, page 1140, and No. 9, June 11th, 1883, page 1315, of the abovementioned journal, in which he speaks of this test with the highest commendation, and shows that by its use a great many determinations in the chemistry of fats heretofore supposed unattainable have been made, and suggests many others which can be accomplished by means of this method of analysis.

X Q. 180. Please read your answer to Q. 30, master's record, page 279, and state whether the opinions you there express are still maintained by you.

A. In the first place, I notice that there appears a manifest error in this answer; for, on comparing the record of the experiments made by me at Cincinnati, they show that the difference in
1488 the product obtained by treating the materials for the same time, with and without lime, under otherwise identical conditions, was about 12 per cent.; and therefore this statement, in my answer to question 30, should be modified by saying, "a gain of about 12 to 20 per cent," instead of simply 20 per cent., as it there appears. Otherwise, I think, the answer is correct.

X Q. 181. You did not state in your answer to Q. 30, nor do you state now, that you are aware that the difference between the result of the treatment with water and the treatment with water and lime more nearly approach each other when increased pressure was used. Do you not think that this fact should also be stated in connection with that answer, in view of the fact that the pressure used by these defendants was, as you know, very much higher than that used in this experiment?

A. At the time of giving this answer I had in view only the process as I saw it carried out at defendants' works, and which, I believed, and do believe, is the process which they were then using, and have continued to use, as regards the degree of pressure; consequently, in stating that answer at that time, I did not contemplate anything beyond this pressure and the result in the manufacture thereby obtained. What would be the result at a higher pressure I am, of course, unable to say; but, from the experience which I had at that time with the coil apparatus, where very much higher pressures were used, and where, nevertheless, 81¼ per cent. of free fat acids was the best result obtained, I do not think it is at all safe to infer that the apparent law of decrease in the efficiency of lime would continue beyond the point at which these observations reached; in other words, these experiments with the coal apparatus seemed to indicate that the best result obtainable without lime, with

an enormous pressure, and even with the development of ac-
1489 roleine, was about 80 per cent., while our experiments show that with very moderate pressures and the use of lime a result at least as good as 95 per cent. was readily secured.

X Q. 182. Did you ever obtain 95 per cent. in any one analysis made by you of any product?

A. (Referring to table). I reached 94.9, which was so near 95 that, for round numbers, I so stated.

X Q. 183. You have referred to a result of certain operations with a coil apparatus in Cincinnati. Are we to understand that you make yourself responsible for the fairness and accuracy of that experiment and apparatus, and that the apparatus (such as it was) was, in your opinion, used in the manner to obtain the best results by it?

A. I don't quite understand what you mean by making myself responsible; but I fully believe, and think that I have good reason for believing, that the apparatus was made and used in such a way as to obtain the very best results of which it was capable; and it is, in fact, my belief that, without fundamental modification of that apparatus, no better results could be obtained by the process which it was designed to carry out.

X Q. 184. Would you wish as much weight to be attached to your opinion on this subject as to your testimony in general?

A. I should, bearing in mind what are its conditions. In other words, to the best of my knowledge and belief, this was a thoroughly fair experiment, in which nothing was neglected that could have been done to obtain a more successful result, were such possible.

X Q. 185. Do you intend to be understood as swearing as a matter of fact that your opinion is, that had the comparative experiments tried by you at Cincinnati been tried at a pressure of from 200 to 250 pounds, instead of a pressure of 131 pounds, that there still would have been a difference of 12 per cent. between the
1490 product of the digester with water alone and a digester with water and one per cent. of lime?

A. This would depend upon the time during which the operations were carried out. If the digestion with water was continued long enough, a product of 88 per cent., or something over that, might be obtained at this high pressure, and then, of course, the comparative experiment with lime would not go 12 per cent. above that; but if the times were such that the digester, with the lime, gave a product which was, practically, thoroughly saponified, I have no doubt that the digester containing the water without the lime would show considerably more than 12 per cent. less of fat acid.

X Q. 186. Question 185 repeated.

A. If the time was fixed and there was no change in the water, I do not believe that, even at a pressure of from 200 to 250 pounds, a better result would have been obtained than was secured by me in the experiment where the materials were heated to 131 pounds for 18 hours. In that experiment the determinations of glycerine, which are shown in Mr. Gamble's letter, indicated that, after a certain point was reached, no further decomposition went on, and it

is my belief that this would likewise be the case, even if the temperature and pressure were increased. Now, if the saponification by water was limited to about 84 per cent., and the saponification by lime reached (as I think it would do under these circumstances) very near to a perfect decomposition of the fat, there would be more than 12 per cent. difference in the result.

X Q. 187. I have not asked you for an argument or for reasons, but I have simply asked you to state, under oath, a matter of fact. Will you say definitely either that you do, or do not, believe that a change in the experiment of the pressure used to a pressure of over 200 pounds would show more or less than twelve per cent. difference in the products?

1491 A. I have already stated my opinion as a matter of fact, and also given you my reasons for it; but if you prefer the opinion without the reasons, I will state that I believe, as a matter of fact, that the difference would be more than 12 per cent. under the conditions named.

Counsel for defendants here moves the master for an allowance of time before the close of defendant's evidence to enable him to have made, or endeavor to have made, with all reasonable diligence, a test of the digester process at a pressure of from 200 to 250 pounds, or, in other words, in all respects in conformity with the description of the answer, as to defendant's process used at the time, with and without the percentage of lime there mentioned; and states that he was under the impression that such tests had been made, and feels himself in part responsible for their not having been made, supposing his error to have arisen from the fact that having been informed a few weeks before the tests were ordered made that the defendants were using exactly the process that they were using during the period of infringement, and having been under this impression thoughout, until the testimony revealed the fact that a change had been made intermediate between his information and the making of these tests, that the process was in all respects identical, he may, in directing experiments to be made, have assumed that the direction to follow out in every particular the process that they were practicing was equivalent to the direction to follow the description of the answer; and may have been less explicit than he should have been, but, because of such impression, in pointing out

1492 the fact that 200 instead of 150 pounds pressure was to be used; and that it is only since so much prominence is given to this discrepancy in the cross-examination that it has seemed to him that there was any occasion for the expense and delay of repeating the test.

Remarks of counsel for complainant and decision of master postponed until next meeting.

Adjourned to Wednesday, July 4th, 1883, at 10 a. m.

Meeting July 4th, 1883.

Master and counsel present as before.

The respondents are allowed until Wednesday, July 18th, 1883,

to make further tests, at which time the accounting will be resumed after adjournment to-day.

Cross-examination of HENRY MORTON continued:

The witness states that he has prepared a table showing the various analyses of material obtained by distillation with superheated steam, as requested in question 174, and has numbered these analyses, consecutively, 1, 2, 3, 4, and 5, analysis No. 1 being the analysis of the first product resulting from a complete operation, which he made in March, and the others the analyses of products prepared by him after his return from Cincinnati, in May and June. It is as follows:

1493

Date.	I. March 31st.	II. May 23rd.	III. May 25th.	IV. June 6th.	V. June 16th
Time of distillation	2 hours	6 h. 10 m.	2 h. 40 m.	2 h. 30 m.	2 h. 20 m
Heat of steam	276° C.	276° C.	291° C.	279°	274°.
" fat		268° C.	286° C.	268°	283°.
" bath	276° C.	279°.5	296°.5	278.5	293°.5.
Per cent. of fat distilled	24.2 p. c.	93 p. c.	76 p. c.	14 p. c.	10 p. c.
Per cent of acid in above	77.5 p. c.	83 p. c.	80 p. c.	86.5 p. c.	88 p. c.
Quantity of steam condensed.		1,060 grm.	400 grm.	250 grm.	200 grm.
Quantity of dry glycerine					
Date of analysis	June 1st	May 30th	May 30th	June 8th	June 18th.

The further cross-examination of the witness is postponed until the next meeting.

Adjourned to Wednesday, July 18th, 1883, at 10 a. m., at a place to be hereafter fixed by the master.

1494 Pursuant to adjournment, the master and respective counsel attended, on July 18th, 1883, at Spring Lake, N. J., but, owing to the fact that the witness, Henry Morton, had not completed the additional tests, adjournment was had to July 20th, 1883, at 10 a. m., same place.

The respondents having completed the additional tests, for which time was allowed from and after July 4th, the accounting was resumed at Spring Lake, New Jersey, on the 20th day of July, 1883, the master being present, and also F. T. Chambers, Esq., solicitor for complainant; R. H. Parkinson, Esq., solicitor for respondents.

JAMES N. GAMBLE was thereupon recalled by the respondents and examined in chief in relation to the additional tests, the cross-examination of President Henry Morton being interrupted for th purpose.

Examined by R. H. PARKINSON, Esq.:

Q. 1. Have you, since the last adjournment, treated any charge of fat in digesters, one or more? And, if so, please describe the treatment of such charges specifically.

A. I have made digestions of fat since our adjournment. On Saturday, July 7th, I made a digestion, A; on Monday, July 9th, I made another digestion, B; on Monday, July 9th, and Tuesday, July 10th, I made a third digestion, C; on Wednesday, July 11th, extending into Thursday, July 12th, I made another digestion, D; on July 12th and 13th I made another digestion, E; on July 13th, extending into the 14th, I made another digestion, F, and on July 14th another digestion, G.

1495 These digestions were performed in a digester on the premises of the Ohio Candle Company, practically similar to those in use in our own works. This digester had been recently put in good order, and was examined by me before beginning the operations. The two gauges which were used, one upon the boiler and one upon the digester, were tested with a standard gauge in my presence, and I noted the comparison, which showed that there was a constant variation between both of these gauges and the standard, at the pressures at which we proposed to use them, of about eight pounds, the gauges being eight pounds light, and in running these digestions this allowance was made; that is, the effort was made to carry the gauge on the digester as near as possible at 233 pounds, which would be equal to 225 by the standard. The figures I will give are the figures corrected to the standard.

The pressure in these several digestions was maintained as near as practicable at 225 pounds standard.

The time of the digestions was, with the exception of the first, equal to the time named in the answer; that is, nine and one-half hours running time, or ten hours, including the time required for change of water, with the exception of some variations which will be named and accounted for.

After the fat of the first digestion had been placed in the digester, the small or man head being off, the pump was set in motion, and its action observed and found to be good—a good discharge. The length of the stroke of the pump was sixteen and one-half inches. The diameter of the piston of the pump was sixteen inches. The number of strokes will be noted in connection with each digestion.

In each digestion two sets of samples were drawn at intervals of one hour, with the exception of the time at which water was changed, when the interval was half an hour; that is, the sample

1496 drawn when the water was changed was a half an hour after the one which preceded it. These samples consisted, in each set, of a half-pound bottle of the fat and a pound bottle of water. In all cases, I believe, the pump was stopped for the drawing of the fat samples in order to obtain clearer samples. Generally, for the first two or three samples, it required three or four minutes to get a clear sample, and the later samples required from a minute to a minute and a half stoppage, with the exception of one digestion, which will be noted. That is general; I have not made that exact; I have them here though.

Each sample of fat was labeled. The first sample taken was of the fat used, and was marked, for the first digestion, "Digestion No. 1, sample A, tallow or fat used;" I don't remember which word I did

have. The second sample was marked "Digestion No. 1, sample B, Stock at one hour, tallow, water, pressure about 225." The successive samples were marked in like manner—that is, "C, Stock at two hours," "D, Stock at three hours," "E, Stock at four hours," "F, Stock at five hours," "G, Stock at six hours," "H, Stock at seven hours," "I, Stock at eight hours," "J, Stock at eight and one-half hours, or, when there was no change of water, nine hours," "K, Stock at ten hours," except in Digestion B, which was marked "K, Stock at nine and one-half hours."

The samples of water were also labeled in a similar manner, that is, "Digestion No. 1, sample P, Water at one hour, tallow, water, pressure about 225;" and in a similar manner for the succeeding hours, that is, "Q, Water at two hours," "S, Water at three hours," "T, Water at four hours," "U, Water at five hours," "V, Water at six hours," "W, Water at seven hours," "X, Water at eight hours," "Y,
Water at eight and one-half hours, or, when there was no
1497 change of water, nine hours," "Z, Water at ten hours," except
in Digestion B, which was labeled "Z, Water at nine and one-half hours."

These samples so drawn were packed in boxes, each containing a series of fat and water samples, and the boxes marked, for the first digestion, A; second digestion, B; third, C; fourth, D; fifth, E; sixth, F; seventh, G; and were expressed to the master's address at New York City:

2 boxes marked A, shipped July 9th.
2 boxes marked B, shipped July 9th.
2 boxes marked C, shipped July 10th.
2 boxes marked D, shipped July 12th.
2 boxes marked E, shipped July 13th.
2 boxes marked F, shipped July 14th.
2 boxes marked G, shipped July 14th.

The contents of the boxes similarly marked were duplicates.

The digestion A was of 6,183 pounds of Amor Smith's tallow and 80.88 per cent. of water by bulk; pressure of about 225; time of operation was about nine hours—a few minutes over nine hours. There was no change of water. The stroke of the pump was sixteen and one-half inches, and its speed at three observations was ten to thirteen per minute. This was slower than during any of the other digestions, the reason being that the engine had more work to perform on that day than during the other days. Perhaps it might be well to note here that the percentage of water was not what we intended; there was water taken in with the fat, and we had a larger quantity than we intended. We intended, really, with that operation, to have about fifty per cent. of water. And it might be well, perhaps, also to note that the first five of these operations we deemed desirable to perform; that the latter two were suggested by the complainant or his attorney.

Digestion B was of 6,191 pounds of Amor Smith's tallow
1498 and 50.03 per cent. of water, the pressure about 225 pounds,
the time of operation 9½ hours, no change of water, length of

stroke of pump 16½ inches, and speed 12 to 14. The actual time was 9 hours and 58 minutes. The pump was stopped for 27 minutes, the chain connection having broken.

Digestion C was of 6,407 pounds of Amor Smith's tallow, 45.20 per cent. of water in each of two charges, pressure about 225 pounds, time of operation 10 hours, water changed at about 8½ hours, pump 16½ inch stroke, speed 14, two observations. The actual time was 10 hours and 20 minutes, the chain in connection with the pump having broken and stopped twenty minutes.

Digestion D was of 6,177 pounds of tallow, about 44 per cent. of which was Amor Smith's and 56 per cent. Shillito's, 50.37 per cent. of water in each of two charges, 61½ pounds of lime were used, the time of operation about 10 hours—a few minutes perhaps over—pump, length of stroke, 16½, and speed 14 per minute.

Digestion E was of 5,232 pounds of tallow—Shillito's tallow—103.28 per cent. of water in each of two charges, 53 pounds of lime were used, pressure about 225, time of operation about ten hours, the actual time about 11 hours and 5 minutes, the pump chain broke, stopped 25 minutes, and lost over a half an hour in drawing off the the first water, pump 16½ inches stroke, speed 14 per minute.

Digestion F was of 5,254 pounds of tallow—75 per cent. of that was Shillito's and 25 the Butchers' Association tallow—102.33 per cent of water in each of two charges, no lime was used, pressure about 225 pounds, time about 10 hours. It was very difficult to get clear samples of the fat—had to stop the pump so much longer than usual that we added 24 minutes to the fifth hour to make the time equal to that of digestion E. I added 24 minutes to the [illegible] hour, which was the time shown by figures was necessary
1499 to compensate for the longer delay. The water was changed at say nine hours—that is, this additional time made it later than usual. Pump, stroke 16½, speed 14.

Digestion G was of 4,815 pounds of tallow—Butchers' Association—536 pounds of fat acids from digestions D and E, making a total of 5,351 pounds. There was 89.77 per cent. of water in each of two charges, no lime used, pressure about 225, time about 10 hours, water changed at 8½ hours, pump 16½ inches stroke, speed 13. The speed was slightly diminished on this day, also, in consequence of the speed of the engine being less, it being more heavily loaded than on previous days.

The three brands of tallow used in these digestions are considered prime tallow. If there should be any difference, the Butchers' Association might perhaps be considered superior. No difference, however, is ever made in the market in prices, and they are considered usually prime tallow, the best tallow, as good as can be had in Cincinnati.

We took special pains to have the pressure as uniform as possible. After beginning the operations I found that the gauge upon the boiler was different from the gauge upon the digester, about seven pounds, and gave directions, therefore, to the fireman to maintain the gauge at the boiler at 240 pounds, which would give the pressure upon the digester 233 pounds by the gauge or 225 pounds by the

standard. The gauge at the boiler was marked, and great care was used, and with, in my judgment, very excellent result in maintaining the pressure. I doubt exceedingly whether in any of our operations, in our regular work, we maintain so uniform a pressure. I was careful to see that the fat went in properly, and that all the operations were carefully conducted.

1500 This difference between the gauges, of about seven pounds, usually exists between the pressure upon the boiler and upon the digester, even where the gauges are equally correct.

The lining of the digester was of copper, the pump brass. Samples were drawn out over an ordinary copper chute that we have from the try-cocks; we took especial pains to wash this out thoroughly with water and fat each time that we drew a sample.

The digester had not been in use immediately preceding these experiments, but it had been recently put in good order and thoroughly repaired, so that it was prepared to bear this pressure.

Q. 2. Can you state what amount of water was used in each charge in the process as carried on from 1870 to 1875?

A. I cannot state positively from recollection of what was absolutely used. My recollection was, however, that it was in each charge about fifty per cent. of the fat, and this recollection is confirmed by the amount of glycerine water obtained.

Q. 3. What percentage of water did you aim to have in the several charges, and how does it happen that the amount given is not an exact ratio?

A. I have explained with regard to digestion A that water was introduced with the fat we didn't intend to put in.

In digestion B the percentage is about what we intended, 50.

In digestion C we by some means got more fat into the digester than we intended and left less space for water.

In digestion D the percentage is very nearly what was intended; the intention was to put in fifty per cent. of water; it proved to be 50.37 per cent.

In digestion E the intention was to put in 100 per cent. of water and it is 103.28.

The percentage in F was intended to be 100 in each charge and was 102.33.

1501 The percentage in G was intended to be 100 and was 98.77. These differences arose from the difficulty of getting the exact amount of fat we intended into the digester. We weighed out an exact amount and made some allowance for what might be left—in the vessels from which we took it to the digester a little would necessarily be left—and when we weighed that back it varied a little in the different digestions, this amount that was left.

The weight upon which the percentage of water given here was ascertained was taken after this remnant was weighed and after the digestion was in progress.

Q. 4. In what condition did the fat go into the digester in respect to temperature?

A. It was thoroughly melted and something above the melting

point of tallow—not, I think, as high as 212. It is difficult for me to say positively what temperature it was at.

It was blown in by steam from a closed tank.

Cross-examination by Mr. CHAMBERS:

X Q. 5. Besides the seven digestions which you have described, have you made any others since the fourth day of July?

A. I did, three others.

X Q. 6. Please state what they were.

A. They were intended to be in this series but through errors they are not correct and were rejected.

I performed two digestions—one on July 10th, which was to have been like digestion D; also on July 10th a digestion which was to have been like digestion E. The samples for these were not sent forward. The digestions were completed, but it was discovered that an error had been made in the quantity of lime used, so that I could not positively state the amount which had been used. Therefore these digestions were set aside.

1502 On July 12th a digestion was performed which was to have been like digestion E. In weighing out the fat for this digestion our weighmaster misunderstood me and weighed the same quantity of tallow as was put into digestion D, or thereabouts. This error was not learned until the lime had been added. I had, therefore, in the digester about 6,100 to 6,200 pounds of fat and 53 pounds of lime, which would represent nothing in this accounting, and the digestion was not finished. It was blown out.

X Q. 7. You stated that these experiments were made at the works of the Ohio Candle Company. These works are practically owned and managed by your firm, are they not?

A. They are, practically; yes, sir.

X Q. 8. Were all the experiments made in the same digester?

A. They were.

X Q. 9. How did you ascertain the amount of percentage of water which you used in the different experiments?

A. By the measurement of the digester, calculating its area and allowing for so many cubic feet of water in volume.

X Q. 10. The water was not actually weighed in any case?

A. No; it was not; it could not be very well. The water is blown in from the boilers under a pressure of 200 to 225 pounds. It is measured by placing in the top of the digester a small cock, to which a pipe is attached. This cock is left open, and when the surface of the water has reached the bottom of the pipe the water comes out. We find the surface of the water in that way.

X Q. 11. In giving the different weights and times did you depend entirely on your own observations or on the reports made to you by subordinates?

A. In regard to times, I depended entirely on my own ob-
1503 servations; in regard to the weight, the weighing was done under my supervision. I did not do the weighing. It was carefully done, and I believe correctly done, and I was careful to see that it was so done. The lime I weighed myself.

X Q. 12. Besides the two samples which were sent in duplicate to the master, as you have stated, did you take any other samples?

A. I drew a few of water and a few of fat acids, the products of the digestions.

X Q. 13. What did you do with these?

A. They are at our works. Some of the samples of water I tested with the hydrometer to see the strength.

X Q. 14. Did you have any analysis made of the fat acids?

A. I did not.

X Q. 15. It is customary, is it not, in the ordinary operation of using the digester to test the progress of the decomposition by taking the specific gravity of the glycerine water from time to time?

A. Well, I should not say that it was customary. It is done at times, but not constantly or as a matter of custom.

X Q. 16. It is, practically, the best test that could be employed during the process of decomposition, is it not?

A. I should regard it as good as any during the process.

X Q. 17. Did you make but one experiment with the addition of a percentage of fat acid to the fat?

A. That is all. It was my understanding that that was about what was desired, and so I made but one experiment.

(The master states that he received by express, in the city of New York, from Cincinnati, fourteen packages, marked, in duplicate,
1504 A, B, C, D, E, F, and G. One of each such packages was forwarded by express to President Henry Morton, at Hoboken, N. J., and the duplicates thereof were forwarded to Booth & Garrett, at Philadelphia, Pa.)

Adjourned to July 21st, 1883, at 10 a. m.

Meeting July 21st, 1883, 10 a. m., at Spring Lake, New Jersey.

Master and counsel present as before.

Further cross-examination of President Henry Morton deferred at the request of the solicitor for respondents, and direct examination resumed in relation to the experiments made since the adjournment on July 4th.

HENRY MORTON recalled for respondents.

Examined by Mr. PARKINSON:

Q. 188. Have you, since the last adjournment, received any boxes of samples from the master; if so, how are these boxes marked, what did they appear to contain, and have you made any analyses of any of the contents of such boxes?

A. I received in all seven boxes marked with the letters of the alphabet from A to G, inclusive. Each box contained two sets of bottles, 10 or 11 in each set—that is, 10 in some and 11 in others. The two sets in each box contained—one of them a fatty material and one of them a watery material, which had the appearance of what is commonly known as glycerine water, derived from the digestion of fats. I did not make any examination of the glycerine water,

but made analyses of as many of the fatty materials as the
1505 time at my command allowed. Four of the boxes only reached me on the 18th, and since then I have kept at the work of making these analyses and preparing the substances for the analyses continuously, until I had just time to catch the train by which I arrived here last evening.

Q. 189. Where were such analyses made, to what samples did they relate, with what facilities and opportunities, and by what process of analyses, and with what results? Please produce, if you can do so, or state, in the form of a tabulated statement, the results obtained from them separately.

A. These analyses were all made by myself in my laboratory attached to my house, and with every facility with the exception of time, this being, as I have already indicated, very limited. I was not able to make duplicate analyses in several cases where I should have liked to do so. The samples analyzed were the whole of the first series and the later members of the other series, going as far back as my time allowed.

I may as well mention here that I consider this series of experiments prepared by Mr. Gamble as having great scientific value, as being probably the first series of any such extent or character which have ever been prepared, and it is my intention, as soon as possible (that is, as soon as I am at liberty from the present examination), to go on with the work of analysis on these samples until I have completed the whole series, making duplicate analysis wherever it seems desirable, and the results of these I will be happy to furnish, as soon as I get them, to any one interested in this case.

(Counsel for complainant calls on the witness to state whether the
the work, so far as completed by him, is sufficient to enable
1506 him to form his opinions, without the possibility of their being modified or changed by the result of a more complete analysis of the samples; and if the experiments made are not sufficiently complete he requests that they be carried on until the witness can be positive that his conclusions will not be modified by further prosecution of the work.)

The WITNESS: As far as these analyses go I regard them as entirely reliable, and do not anticipate that any conclusions which I can draw from these will be modified by the further work which I propose doing in filling up the series of analyses as I have stated. I do anticipate that I shall be able to draw a great many conclusions from the complete data as to the composition of all the specimens prepared by Mr. Gamble, but of course I cannot now even know what those additional conclusions may be, but see no reason why they should modify any that can be founded on what is already accomplished.

As a matter of fact I have as yet had no time to carefully study these results. The larger part of them were calculated out last evening as I rode down here on the cars, and were entered on the table this morning. I can, however, see that there are many questions which could not possibly be answered on the basis of the analyses

already made. For example, if it were asked, What is the effect of adding free fat acid to the contents of the digester? it would be impossible for me to make any reply founded on the three analyses out of the series of eleven substances involved in that particular experiment. If, therefore, I was mistaken in the impression I got up to this point, that my work in making these analyses and my testimony in reference to them was simply to be confined to such such analysis and the statement of results, and it is proper
1507 that I should testify as to conclusions and deductions from them, it would then be necessary for me to complete the analysis of all or nearly all the specimens which have been referred to, which would of course occupy a considerable time. In other words, I should work this matter up exactly as I would the research for publication which I propose to make.

(Thereupon, after discussion participated in by the master, counsel, and witness, the solicitor for respondent requests postponement of the accounting until the analyses can be completed, and after consultation with the witness such postponement was had until Saturday, July 28th, 1883, at 10 a. m., at same place, Spring Lake, New Jersey.)

Meeting at Spring Lake, N. J., July 28th 1883.

Master and counsel present as before.

Examination of HENRY MORTON continued:

Q. 190. Have you since the last adjournment made any further analyses of the samples referred to at the last meeting, and, if so, can you produce a table showing the results as well of these analyses as of those referred to in the last question? And complete your answer to the last question, including therein as well analyses made and the results obtained since said adjournment as those to which the question specifically related.

A. Since the said adjournment I have made a large additional number of analyses, having in fact analysed all but fifteen of
1508 the seventy-six samples of fatty material sent me, and made duplicate analyses in several cases. I produce a table showing the results of these analyses, and have marked on the same the figures 2 or 3, as an exponent, where the results given are the average of duplicate or triplicate analyses.

(Said table is here offered in evidence and marked "Def'ts' Exhibit Table of Analyses at 225 Pounds.")

My only reason for not completing analyses of all the samples sent me was that I found the time too short, and, though I worked until there was just time to catch the latest train last night, it was impossible for me to complete them all. Those I left incomplete were those which seemed to me to have least bearing upon the questions here involved.

To return to the previous question, the answer to which I left incomplete, I would say that the method of analysis used by me was

that which I have described in general terms in my testimony given in Cincinnati, and which, as I then stated, was first announced by Hausamann, in Dingler's Polytechnic Journal, and it seems to me that this would be an appropriate place to offer a translation, which I have had prepared, of the article in question for convenience of reference.

(The translation referred to is here offered in evidence and marked "Def'ts' Exhibit Hausamann Article.)

It is to be understood that the process as originally described by Hausamann has been modified by me in the manner that I will presently explain, and, as illustrating the reasons for those modifications, and as supporting their propriety, I would desire to refer to certain articles which have been, I think, already alluded to in
1509 my testimony, and of which I have also translations as well as originals here with me, these being two articles by Max Groger, published in Dingler's Polytechnic Journal in 1882, vol. 244, page 303, and vol. 246, page 286, respectively, and an article by Carl Zulkowski, published in the Transactions of the German Chemical Society for 1883 at page 1140.

(The translations referred to are offered in evidence and marked "Defendants' Exhibit Groger Article No. 1, Groger Article No. 2, and Zulkowski Article," respectively.)

The method of analysis pursued by me in full is as follows: The prepared sample was weighed out to the amount of 5 grammes. This was dissolved in 100 cubic centimeters of pure hot alcohol, of 96 per cent. This is known in the market as Webb's 96 per cent. cologne spirit. When the fat was thoroughly dissolved, if possible, by heating the alcohol (and this was the case in all but a few samples containing very little free fat acid, and in those cases the heating was continued, with frequent shaking, until I was convinced that all the free fat acid was dissolved in the alcohol), the solution or mixture was brought under a burette containing a standardized solution of caustic soda in alcohol, approximately normal, and this soda solution was allowed to flow slowly into the solution or mixture (to which a few drops of alcoholic solution of phenol ophthalein had been added as an indicator) until an easily recognized red tint was produced, which indicated that a very slight excess of caustic soda had been added beyond that required to neutralize the free fat acid, thus rendering the fluid faintly alkaline. The amount of the soda solution required to produce this effect was carefully read off on the burette, and then an additional amount added, so as to secure a large excess of soda beyond that which would
1510 be needed to saponify any remaining neutral fat. The mixture was then heated so as to gently boil for thirty minutes, after which the vessel containing it was placed under a burette supplied with a normal solution of sulphuric acid, and this added, drop by drop, until the red color disappeared. The amount of the normal solution of sulphuric acid required to accomplish this result was also noted; and this, with the previous determination of the alkali

needed to obtain a red color, and of the total amount of alkali added, gave the data for each analysis. In order to use these data, it was necessary, of course, to know the exact relation between the acid and alkaline solutions under the circumstances of their use, and this was done by taking 100 cubic centimeters of the same alcohol, adding to it the indicator, heating it, then adding five cubic centimeters of the alkaline solution, boiling the mixture for half an hour, and then adding from the normal acid solution until the red color disappeared. The amount of normal acid solution required for this purpose was carefully noted. Then five more cubic centimeters of the alkaline solution were added to the mixture, it was boiled again for half an hour, and acid from the normal solution again added until the red color disappeared, showing that the alkali had been neutralized. By a comparison of these results it was, of course, easy to determine both the ratio of the acid to the alkali solutions and also whether the alcohol contained any acid or other material capable of influencing the results. By using the pure alcohol, which I have described, I found that no appreciable correction was needed on this account, but have taken, as a precaution, in each case, the second determination as the more reliable, since any substance in the alcohol reacting in any way with the alkali would have been eliminated by the first treatment. With the ratio between the alkaline and acid solutions determined, as I have just described, the method of calculating out the results of analyses
1511 then consisted in multiplying the amount of acid used in the final step by this ratio, and then substracting the number so obtained from the total amount of alkali used. This difference represented the amount of alkali required to neutralize the entire fatty acid, either free or combined, in the sample, and by dividing this quantity into the amount of alkaline solution first used to neutralize the free acid in the mixture the percentage of free to total acid was directly obtained. The conditions under which these analyses were made were, as I have said before, favorable in all respects, except that the limit of time did not allow me to duplicate them all, or nearly all of them, as I should like to do; but, as they stand, I feel satisfied that they are correct within one per cent.

I should also remark here, as bearing upon their value, that, almost without an exception, the calculations from the data obtained, as I have described, were made after I left my laboratory, and there has been no sort of selection between the different results, nor any knowledge on my part, at the time I was making one analysis, what bearing it had or might have on others, or on the subject at large. I simply obtained the data for calculation, and the results, as shown in the table, were calculated afterward. There are one or two exceptions to this general statement, as, for example, I recollect one case, in which an analysis made very late in the day, when the light was bad, was noted, but afterward discarded as presumably incorrect, and another case in which I allowed too much acid to run in, and though I attempted to titrate back, as it is called, technically, by adding alkali, yet was not satisfied with this irregular operation, and rejected this analysis also. The first analysis to which I have

alluded was that of sample 1 of series number 2, which I made on the 17th of July, between 6.05 and 6.35 p. m., and which I rejected—hence it does not appear on the table. This rejected analysis,
1512 I may here mention, showed 89.8, and the accepted analysis, as the table shows, is 91.6, a result of two determinations. The other case was an analysis of the sample number 4, 1, where I overran the acid, and that result was 94, while the correct one subsequently made was 91.3. Those that I have referred to are, I think, the only cases in which I have rejected any analysis which I have made; otherwise the table embodies the entire work which I have done on this subject.

Quite as important as the method of analysis used is the preparation of the samples. I will, therefore, describe this. As a considerable number of these samples contained lime, it was of course necessary to remove this lime previous to making the analysis. This I did by taking fifty grammes of the sample, putting it in a beaker, adding ten cubic centimeters of a solution of sulphuric acid made by mixing one part of chemically pure sulphuric acid, by weight, with five parts of water, and also adding one hundred cubic centimeters of water. This mixture I heated on a water bath, with constant stirring for 15 minutes. I then set it aside and allowed it to cool, pierced two holes through the cake of fat, allowed the water to run out, rinsed it, filled it up with water again, again placed it on the water bath, and stirred it for five minutes after it was melted, again allowed it to cool, and removed the water as before. This process I repeated until the water, which had been heated and stirred up for five minutes with the fat, showed no trace of sulphuric acid on testing with litmus-paper, after which I treated it once more with water, and then having poured the water off melted the fat and filtered it into a bottle. In order that everything might be identical with the various samples, I, in the first instance, treated also those which did not contain lime in the same way, except that I used only half the amount of dilute sulphuric acid, but on my re-
1513 turn to Hoboken last Monday I made several experiments by treating two of these samples, which did not contain lime, with acid as above, and also by simply washing them once in the same manner—that is, by melting and stirring with water, then removing the water and filtering. The analyses of these being in one case absolutely identical, and in the other case only differing by one per cent., I concluded that the treatment with acid for the samples not containing lime was unnecessary, and therefore after this only washed in the manner I have described, with water, those samples which contained no lime.

I also made determinations of the specific gravity of the glycerine solutions sent to me. These were made by pouring the contents of the bottles, one after the other, into a specific gravity jar or hydrometer jar, and floating in it a delicate hydrometer, one of a set of six, which enables one to read actual densities to $\frac{1}{1000}$th of the density of water, water being taken at a thousand. Some of these liquids contained a considerable amount of fat which existed in them as so permanent an emulsion that it could not be removed by filter-

ing through the ordinary chemical filtering paper. I, however, filtered several which were in this state, but did not find any notable difference between the filtered and unfiltered liquid; therefore I did not take up the time required to filter all, nor do I think that any great modification in the densities has been caused by this condition, having in view the care which I took to get rid of the fatty matter as much as possible where it was floating on the top in emptying the bottle. Being somewhat limited for time, and the liquids in series No. 1 showing considerable sign of fermentation, I did not attempt to determine their densities, this series also, as I understand it, being of little importance as not representing any condition which I understand to be involved. But I have obtained the densities of all the others, and present this table on which I have written
1514 them out. On this table I have marked a vertical line opposite the numbers where there was a great deal of fat with the glycerine water. The determinations of series 2 and 3 were made and noted down by myself, and the rest of them, as I had not time to accomplish it, were observed and noted by one of my assistants under my immediate supervision and instruction.

(Table last referred to is offered in evidence and marked "Def'ts' Exhibit Table of Glycerine Water, Densities at 225 lbs. Pressure.")

Q. 191. How, if at all, are the opinions heretofore expressed by you as to the relative efficiency of the Tilghman process (I mean the Tilghman process unmodified, except in respect to mechanism and degree of pressure) and the process used by the defendants affected by the results of the analyses or other investigations made by you since the adjournment of July 4th?

A. I have made no investigations on this subject since the date you have mentioned, but have, of course, made a number of analyses of the products obtained by Mr. Gamble, and the results of these analyses seem to me to support in a very remarkable way many of the opinions which I have already expressed as founded on previous experiments made by myself or others. Thus I had stated before that in the process as carried out by the defendants I considered that the one per cent. of lime employed was a most efficient factor in the production of the result obtained, and this opinion I find confirmed in the most marked manner by these analyses. Thus, if we compare together series Nos. 2 and 4, which, as I understand, are alike in their conditions, except that in No. 2 no lime was used nor was the water changed, while in No. 4 one per cent. of lime was used and the water was changed between the times when samples
1515 J and K were taken, we shall see, in the first place, that in a single hour where the lime was present about 65 per cent. of free fat acid was developed, and that in three hours 91 per cent. of free fat acid was developed, which was only reached in the process 2, where no lime was present, at the end of eight hours. In fact, where the lime was absent and no change of water occurred, at the end of 9½ hours only 91.5 per cent. of free fat acid had been obtained, and the fact that only a variation of 1 per cent. occured in this experiment from the 7th hour to the end of the operation,

seems to me to indicate that with the conditions then existing no appreciable increase in the yield of fatty acid would have been obtained in any reasonable time. Even where a much larger quantity of water was used, as in experiment No. 1, where 80 per cent. of water in place of 50 was added, the final result is practically no higher. It would also appear that, under the conditions of the patent as to the amount of water employed and the conditions of time and pressure stated in the answer, the product produced would have contained at the best under 92 per cent. of free fat acid. Such a product was notably inferior in purity, and, therefore, manifestly less valuable than that obtained by older processes. To bring the product from this condition up to one in which its purity would be equal to that of the product obtained by older processes it would appear that a change of water is absolutely necessary, together with the aid of lime. These analyses seem to show that this change of water had the effect of increasing the free fat acid in the product by from four to five per cent., wherever such increase were possible without getting beyond 100 per cent. Thus, in series No. 3, the change of water increases the fat acid by four per cent.—that is, from 92.3 to 96.4; in No. 4 it changes it just five per cent., from 92.7 to 97.7; in No. 5 the change of water only raises the fat acid 2.6, from 96.7 to
1516 99.3, but it is manifest that having got to 96.7 there was not room enough for a five per cent. addition. In series 6 the change of water causes an increase of fat acid of about four per cent.; here again, however, the result approaches close to the possible limit. In No. 7 the increase produced by the change of water is about four per cent. in this sample, also the product having reached 94.7 per cent. prior to the change of water. The remarkable action of lime in facilitating the saponification is also strongly shown if we compare samples D, obtained at the end of the third hour, in digestions 2, 3, 4, and 5, 2 and 3 being without lime and 4 and 5 with. In this case, without lime, at the end of the third hour, we obtained in one case 56 and in the other case 51 per cent. of free fat acid, and with lime 91 and 93, an increase of more than fifty per cent. on the amount obtained without lime.

Another curious effect exhibited by these results is the following: Where lime is present it would appear that almost the maximum result, especially where the amount of water was fifty per cent., is obtained at the end of the third hour, and that after this the subsequent digestion seems to have little or no effect. The small fluctuations, for instance, which are shown in series 4, between sample D and sample J, I should regard as being within the limit of error in such a method of analysis, or very nearly so, and that these results show a practical identity between the sample taken at the end of the third hour and that taken at the end of eight and one-half hours. In the sample in series 5, where the amount of water used was equal to that of the quantity of the fat, there is a gradual increase, amounting in all to about three per cent., between the sample taken at the end of the third hour and at the end of eight and one-half hours; but, in any case, it would seem from the results of these analyses

that, where lime was used, if the process had been carried out
1517 for three hours, the water then changed and the action continued for perhaps an hour more, a practically perfect saponification would have been secured—that is to say, one of 99 per cent. free fat acid, and, therefore, that in this case the addition of one per cent. of lime would have reduced the time to one-half. Or, again, if we compare the digestion No. 4 with digestion No. 2 we see that where the lime was present the result of 91 per cent. free fat acid was obtained at the end of three hours, and without lime, in series 2, at the end of eight hours; therefore the efficiency of the lime as thus shown, or its capacity of effecting saponification under conditions otherwise identical, is expressed, I think, by this time relation of 3 to 8—that is, it could do in three hours what otherwise required eight. Or if we look upon the process as a process of effecting something, the one per cent. of lime doubles the efficiency of the general process of effecting this saponification. It is true that in the process used by respondents at the time referred to the heating was continued after 91 per cent. of free fat acid had been obtained, with no practical effect for five and one-half hours more—in other words, the lime having done the work in three hours, the water, under pressure, had nothing to do and accomplished nothing in the remaining five hours, and the final pure product was obtained by the additional action of the changed water. These results, looked at in this way, seem to me to support what I have previously said as to the great importance of those modifications of the Tilghman process involved in the use of lime and the changing of the water, which constitute the distinguishing characteristics of the process as used by respondents.

In certain respects my previous impressions have not been fully sustained, and I will proceed to point these out. It was my opinion, from the experiments which I had made, or of which I was cogni-
1518 zant, that it would be impossible, by the action of heat and water alone, at any pressure, to get a better result than was obtained in the experiments which I witnessed at Cincinnati with the coil apparatus, where so very high a pressure and heat were used. But these results show that, with the amount of water mentioned in the patent, as good a result as 91.5 per cent. of free fat acid, in one case, and 92.3 in another could be obtained without the use of lime or change of water, where the pressure was carried up to the point of 225 pounds, in a closed vessel with a stirring apparatus, and was so maintained for 9½ hours. But, as I have already explained, I do not consider such a product as coming up to the requisite standard of purity in a material to be employed for the manufacture of candles at the date of the patent.

Those are the only points that now occur to me, though there may well be others which I should realize on carefully reading over my testimony.

(Counsel for complainant objects to so much of the above answer as describes a hypothetical process and institutes a comparison between it and the process which counsel describes as the Tilghman

process, as irresponsive to the question and as entirely irrelevant to any matter at issue in this accounting.)

Adjourned to same place, at 10 a. m., on July 30th, 1883.

1519 Meeting at Spring Lake, N. J., July 30th, 1883, 10 a. m.

Direct examination of HENRY MORTON closed and cross-examination resumed.

By Mr. CHAMBERS:

X Q. 192. Please read over my cross-question No. 185 and three answers which you gave to that question, and state what corrections you wish to make in your answers to that question.

A. I have no other correction to make to those answers than that which I have already made at the conclusion of my direct testimony at the last session, namely, that from these experiments I find that a better product could be obtained at a pressure of 225 pounds in nine hours than was obtained by me at a pressure of 131 pounds in eighteen hours. I had supposed, from the failure to produce even as good a result, with the pressure of 2,000 pounds, in a coil apparatus, that it was not likely that any improvement would result from mere increase of pressure; but these subsequent experiments have shown that, using the digester form of apparatus, a better result was obtained at 225 pounds pressure than was secured in the coil apparatus at 2,000 pounds.

X Q. 193. When you speak of the coil apparatus in your above answer, do you mean to be understood as referring to those experiments made in your presence at Cincinnati, or to be speaking generally?

A. I have, of course, especial reference to the experiments which I myself witnessed in Cincinnati, but I regard those experiments as a fair expression of the capacities of that apparatus, and believe that the results of those experiments fairly exhibited the capacities of the coil apparatus described in the Tilghman patent.

X Q. 194. Do you not think that you should speak with a
1520 little less confidence on this subject, in view of the fact that you have been forced to acknowledge that every conclusion you drew as to the capacity of the process in a digester form of apparatus to be false?

A. I do not, for this reason: In so far as my earlier conclusions have been modified by subsequent experiments, they were conclusions which went beyond and outside of the conditions of the earlier experiments from which they were drawn; but in what I said in reference to the coil apparatus I founded my opinion upon experiments involving, as I understand, all the conditions set forth in the Tilghman patent in reference to the structure and use of this apparatus; therefore I do not see any room here for any new or different result, unless under conditions which were such modifications as would be excluded as not being within the Tilghman patent.

X Q. 195. Are you aware of the fact that the statement which you made as to the condition of the emulsion in the coil apparatus as it

left the machine is flatly and directly contradicted by another expert employed by the defendants to assist in those experiments?

A. I am not.

X Q. 196. You stated, in answer to question 9, master's record, page 257, that in the experiments which you witnessed "the emulsion flowed in a smooth, regular stream almost throughout. Just at the start there was a momentary obstruction and rush of the emulsion, but this was not repeated, so far as my observation went, although there was a little variation in the rate of flow, due, as I believe, to small irregularities in the working of the pump, which were, no doubt, also the cause of the variations in the pressure. I think that covers the ground." Mr. William L. Dudley, who was employed as an expert by the respondents, states as to this same experiment

1521 as follows, at page 220, cross-question 4: "In some cases the flow would altogether cease for a few seconds; then it would begin again, sometimes running watery, having a turbid appearance, and then it would sometimes change from that to a thick, curdy mass, which would be squeezed out through the opening. The changes, as a general thing, were not very sudden—that is to say, it would not go by sudden impulses or spurts; it would run out, but vary in that way; sometimes it would close off; then it would start again, run fast or slower, as the case might be. Now, then, I think on one or two occasions, where the pipe seemed to get clogged, it would throw out the mass with some considerable force. We were more liable to notice that in the beginning of the operation than when we got under way." Do you wish, in view of Mr. Dudley's detailed description of the manner in which this emulsion came out, to reiterate and stand by your statement in answer to question 9?

A. I do. The only time that I noticed any irregularity in the flow, except such as I have indicated in my previous answer, was just at the starting, when such an obstruction and sudden outgush took place, as I before indicated, but after this I saw nothing of any such extreme irregularities as Mr. Dudley seems to describe. In fact, I do not see how the samples could have been collected, as I know they were, did such irregularities occur, since, in the instance which I have referred to and when I was about to collect the sample myself, I was very thoroughly splashed with the mixture as it struck the bottle which I was holding to collect a sample.

X Q. 198. Mr. Dudley states that these sudden impulses occurred only on one or two occasions, and in this he quite agrees with your own statement. The other changes, he says, took place gradually, and in that case there would be no difficulty in collecting samples, would there?

1522 A. That would, of course, depend upon the circumstances of the case, but, as I have already said, I did not notice such changes as are here referred to either at the time —, nor did I observe any irregularity in the samples as to the quantities of fat and water present therein, which I think would have attracted my attention had they existed.

X Q. 199. Mr. Dudley swears that this state of facts existed. Do

you mean to be understood that this state of facts did not exist, and as founding your opinion on the fact that you did not notice the existence of these facts?

A. I mean to be understood as swearing that, to the best of my knowledge and observation, the state of facts which existed were precisely those which I have described in my former testimony, and that in so far as the statement made by Mr. Dudley may seem to be at variance with the statement which I have made this variation may result from some difference in his method of stating or his means of observation. I cannot, of course, be expected to swear to anything but what I myself have seen and know in such a matter; certainly not to swear on the basis of the absence of observation or knowledge.

X Q. 200. Who collected the samples in this experiment?

A. I myself collected the first one, and after that one of the assistants, at Mr. Gamble's request, though I watched the operation near by.

X Q. 201. Mr. Dudley was examined as a witness on behalf of the respondents, and in answer to question 6, on page 219 of the master's report, stated that he collected these samples. Is he the assistant you referred to?

(Objected to as misstating the witness' testimony. Objection overruled.)

1523 A. I do not so understand Professor Dudley's testimony. In the answer to which you refer he is asked about a number of experiments, and, referring to these in general terms, states he "watched the samples, collected the samples, also took note of the pressure and watched the temperature of the coil—that is, whether it was melted tin, lead, bismuth, and so on." Now, it is to me manifestly impossible that on the occasion when I was present Professor Dudley could have done all these things, as the taking of the temperature required him to be at a considerable distance from the place where the samples were to be collected, and when I collate this answer with Prof. Dudley's answer to cross-question 2 it appears to me perfectly plain that he was speaking of collecting the samples in the previous cases and not in the one where I was present, since he very specifically states, "The samples were collected directly by Prof. Morton and Dr. Endemann, and analyzed by them."

X Q. 202. As I understand you, as a matter of fact, you collected but one sample?

A. With my own hands—yes. On the occurrence of the splashing Mr. Gamble insisted upon having one of the workmen or employes of the establishment hold the bottle, though I offered to continue my office, Dr. Endemann having his note-book in his hand and taking the note of the times when the samples were collected, while I watched the operation myself with Dr. Endemann.

X Q. 203. To return to your answer to cross-question 185: You admit, I understand, that your answer to that question, printed at the top of page 360, was not correct?

A. I do.

X Q. 204. You have marked on the table of analyses last put in evidence by you a number of factors indicating the number
1524 of analyses made of certain samples; for instance, samples E of digestion No. 2 or B is marked as the mean of two analyses. Please state what these two analyses were.

A. 75.8 and 74.3.

X Q. 205. What two analyses make up the result given by you as the sample H of digestion No. 2?

A. Two identical results. They chanced to come out on both occasions 90.5, 90.5.

X Q. 206. Please give the two analyses making up sample I of digestion No. 2.

A. 92 and 91.3.

X Q. 207. Give the two analyses from which you find sample H, digestion No. 3.

A. 91.4 and 89.5.

X Q. 208. Give the two analyses from which you deduce B of sample No. 4.

A. 65.6 and 64.6.

X Q. 209. Now, as to sample H of digestion No. 4?

A. 93.4 and 91.7.

X Q. 210. Sample I of digestion No. 4?

A. 91.3 and 90.2.

X Q. 211. Sample E of digestion No. 5?

A. 94.8 and 94.6.

X Q. 212. The three analyses from which you calculate sample I of digestion No. 7?

A. These are 96.3, 94.2, and 93. In reference to this I desire to remark that the first of these analyses, had I simply used my judgment, I should have discarded as being made under unfavorable conditions; but, as I had stated that I included all my analyses, except certain specified ones, I felt myself bound to include it.

X Q. 213. Now, as to sample J of digestion No. 7?

A. 95.6 and 93.8.

X Q. 214. Are those that I have mentioned the only samples of which you made more than one analysis?

1525 A. Those are the only ones, with the exception of the two rejected analyses, which I stated on Saturday.

X Q. 215. Please state which of the samples of digestions Nos. 1, 2, 3, 6, and 7 you treated with acid to remove any base that might exist in it in the same way that you treated the samples of digestions Nos. 4 and 5.

A. I now mark with a star on the table "Def'ts' Exhibit Table of Analyses at 225 Pounds," all the samples treated with sulphuric acid.

In the cases of samples E and H of digestion No. 2, where I report the average of two analyses, one analysis in each case was made on a sample treated with sulphuric acid and the other on one treated only with water.

In the case of E of No. 2 the sample treated with water alone gave 75.8 and the sample treated with acid gave 74.3.

In H, No. 2, the two results were identical.

X Q. 216. The results of these two determinations, then, and especially of sample E of digestion No. 2, would indicate that you were wrong in your assumption that this acid treatment of the sample would show a larger percentage of fat acid than where the sample was not so treated?

A. I do not recollect having made this assumption; but it is, of course, *a priori* probable and to be looked for that, if any appreciable amount of base were present, a higher result would be obtained if the material were treated with acid beforehand. This probability, however, is founded on the assumption that there was an appreciable amount of base present. This supposition as to the presence of a fixed base in these samples, however, I know now, though I did not know and had not time to find out at the time I was making these analyses, is incorrect. The total amount of fixed base
1526 in one of these samples, which I selected at hazard and caused to be accurately analyzed, was only four-hundredths of one per cent. I cannot identify the particular sample, but it was analyzed by Dr. Endemann, to whom I took it, having entire confidence as to his capacity, and not having time to make a thorough analysis of this sort myself. But, not thinking of it otherwise than as a matter for my own information, I did did not take a note of which sample, being able to determine that at any moment by looking at the bottles which were left.

X Q. 217. Of the nine duplicate analyses which you made I find the differences to be, respectively, 1.5 per cent., nothing, 0.7 per cent., 1.9 per cent., 1 per cent., 1.7 per cent., 1.1 per cent., 0.2 per cent., and 1.8 per cent. Is this correct?

A. I have not verified the figures, but I have no doubt it is.

X Q. 218. And in one of the analyses which you made in triplicate I find the difference between the highest and the lowest result obtained by you to be 3.3 per cent., the difference between the highest and the next to the highest analysis to be 2 per cent., and the difference between the two lowest results to be 1.3 per cent. Is that right?

A. I have no doubt that that is also correct, but would here remark that, as I have stated before, the first and highest of these analyses was made under unfavorable conditions, and would have been rejected by me had I not already stated that the table included all my analyses.

X Q. 219. It is impossible for you to say, is it not, that in any one of the cases where you have made duplicate analyses the true result lies between those analyses? I mean you cannot assert this as a matter of fact.

A. It is simply a question of the calculus of probabilities, and, as I understand it, it is extremely probable that the true result
1527 lies between or is expressed approximately by the average, where duplicate analyses have been made. The main source of error in these analyses is the chance of running in a little too much of the acid or alkali solutions, and in the uncertainty in reading the level of the liquid in the burette, and these sources of error

are just as likely to produce too high as too low a result; therefore, as I understand it, the probabilities are very greatly in favor that in duplicate analyses the errors should balance.

X Q. 220. The analyses K, J, and I of digestions Nos. 3 and 4 are to be taken as substantially the same, are they not, in view of the uncertainty of the method within the limits indicated by the duplicate analyses?

A. They are.

X Q. 221. Two of your analyses of samples H of digestions 3 and 4 came within three-tenths of each other. This would indicate that there can be no great diference, if any, between these two samples, would it not?

A. It would indicate that the difference must be small, probably not over a — per cent.

X Q. 222. The analyses of samples K of digestions 5, 6, and 7 give substantially identical results, do they not?

A. They do.

X Q. 223. And the analyses of samples J of digestions 5, 6, and 7 would not indicate with any certainty that there was a substantial difference between the samples, would they?

A. Not if they stood alone, but taken in connection with the analyses of the previous stages in those digestions they would, I think, show decidedly that there was a higher result with digestion 5 than with either of the others.

X Q. 224. Looking at these previous results, and taking
1528 samples I of 5, 6, and 7, and bearing in mind your admission that one per cent. should be allowed for error of analysis, are not these three substantially identical?

A. They are; but, of course, I did not confine my reference to this single stage in my last answer, but to the fact that, taking all the stages in these digestions, digestion No. 5 shows a decidedly higher proportion of free fat acid than do the others.

X Q. 225. I do not altogether understand you. Do you mean that because No. 5 is higher than No. 6 on the third samples, that, therefore, your analysis on the eighth and ninth samples are worthless, and the conclusion to be drawn, in spite of this analysis, that the digestion in No. 5 was more complete than in No. 6?

A. Not at all. I have said nothing on which any such conclusion could be legitimately founded. What I intended to indicate, and what the table very plainly shows, is that in No. 5 the development of free fat acid began very early and reached a very high degree, so that at the end of the third hour I found 93 per cent; that afterward, as in the case of the other digestion where lime was used, the increase was gradual and small, while in digestion No. 6, where no lime was present, the development of free fat acid was very much slower, so that at the end of the third hour only 55.3 per cent. had been liberated, but that this development then continued at a pretty regular and gradual, though decreasing, rate of advance, by reason of which at the end of eight and one-half hours the products of the two digestions closely approximated, or, in other words, that the one containing no lime had nearly got up to the one which con-

tained it, and when the water was changed then every remaining difference was obliterated by the action of this change of water, which had in itself a capacity for doing much more than was called for to produce practically pure products in both cases. I do
1529 not myself regard any deduction which was founded on the comparison of a single pair of analyses as having much weight, but I do regard deductions drawn from such series as these and showing progressive changes as having very great weight.

X Q. 226. Comparing the two processes indicated by digestions 3 and 4, which, in your opinion, gives the best results?

A. No. 4, slightly.

(X Q. 227. None—error in numbering.)

X Q. 228. In making this statement do you bear in mind that none of the last figures of your analyses are the results of duplicate analyses, and that, from your own admission, you must allow at least one per cent. for possible error? Considering these facts would it not be fairer to say that the results are to be taken as substantially identical?

A. If I confined my comparison to those figures alone I should agree with you, but if I took into consideration the previous terms of the two series, then I think they indicate a strong probability that repeated analyses would rather tend to raise the final figure in series 4 and lower it in series 3.

X Q. 229. Yet in the eighth samples taken of these a duplicate analysis of that from No. 4 gave you a result of 90.7, while the companion analysis of digestion No. 3 stands in your table as 91.5, indicating that by the eighth hour the two digestions were, to say the least, equally complete. Is not that so?

A. The facts you state are true; and, again, if the attention is confined to those particular samples, your deduction would be perfectly fair. But when we notice that the result 90.7, in series No. 4, is manifestly lower than any of the four previous results, it leaves us the choice between the very improbable supposition that there was in this case a loss of free fat acid after it had been developed, or that some unexplained condition in this particular sample causes it to be abnormal, and authorizes us in disregarding it in view
1530 of the opposite indications of the rest of the series rather than disregarding the fivefold weight of evidence derived from the previous five samples.

X Q. 230. The previous five samples of digestion No. 4 indicate that little or no action was going on from the period during which they were taken, while the corresponding samples of digestion No. 3 indicate that a constant and steady action was going on tending to raise the contents of that digester to a level with the other. Is not that the case?

A. That is the case.

X Q. 231. You stated in the testimony in which you introduced the table to which we have been referring that the analyses were to be taken as correct within one per cent. Are we to understand you now as asserting that wider latitude must be allowed for your errors?

A. In the first place, I do not understand that I have, in any place, stated that any latitude whatever is to be allowed for my errors, but that I considered this method of analysis capable of giving results reliable to even one per cent., and that, therefore, the results which I had obtained by it were reliable within that limit; and I do not now state that any wider latitude as to the limit of accuracy of this method of analysis is to be allowed. But I do state that, while the comparison of a pair of analyses could not be relied upon to decide a question which turned upon even two or three per cent., yet we may form reliable conclusions, far within such a limit of difference, when the analytical results are considered in connection with other results obtained from samples prepared in connection with the special ones first referred to, and have also in mind the conditions existing in the process by which the samples were produced. Thus, in this particular case, while it is manifestly true that in the samples J of No. 3 and No. 4 the analyses showed a practical identity in the free fat acid, as we understand it, yet,
1531 in sample No. 4, we know there is lime soap present in the digester at the time that sample was taken, while there was none in the digester No. 3 when its sample J was taken, and, therefore, we have reason to expect, when the fresh water was added, that a better effect in the production of fat acid would be obtained in No. 4 than in No. 3, and for this reason, as well as others, may fairly conclude, as I have stated, that the probabilities are strongly in favor of the assumption that the result of the single analysis of sample K in series 4 is too low, and that of sample K in series 3 is too high.

X Q. 232. And yet you were content to let both of these analyses rest with a single determination, while, with intermediate terms, you went to the trouble of duplicating them?

A. I was not at all content to leave these but, as you well know, was limited practically by lack of time, so that I was able to duplicate very few, and did not attain such results as enabled me to see the bearing of the question until I had left my laboratory, and was, in fact, guided as to the matter of duplicating results only by the consideration of some doubt as to the accuracy of an analysis, or in the case of the two duplicates in series 2, made with and without acid treatment, by the object I there had in view of comparing the effect of these treatments on appopriate samples.

(At the request of the solicitor for complainant, the master states that the time deemed necessary by the witness at the date of adjournment, on July 21st, was allowed.)

The witness desires to state that in naming the time at which he believed he could complete these analyses he did not feel himself at liberty to make a liberal allowance, but, on the contrary, under the pressure of the necessities of the case, as regards the
1532 engagements of others and the closing of the testimony, named the very shortest time in which he then believed it would be possible for him to complete the work in a manner in any way satisfactory to himself, and of course did not contemplate so

completing it as to make sure that his results would meet every question that could be raised in reference to them. He would further state that he did his very best within the time to accomplish what, as far as he could see, would be the most desirable and important part of the work.

X Q. 233. In your analyses of digestions 4 and 5 your results comprise both the free fat acid existing in the digestions and the fat acids combined with lime and existing in the sample as lime soap, do they not?

A. They do.

X Q. 234. What per cent. of the fat acid in samples K of digestions 4 and 5 was present, not as free fat acid, but as lime soap?

A. I made no determination as to this.

X Q. 235. You have stated, as I understand, that you do not think more than 81 per cent. of fatty acid could be obtained in such a coil apparatus as that described by Mr. Tilghman in his patent. Am I right in so understanding you, and, if so, do you wish to make any qualification of the statement?

A. You are right in understanding that I have stated in substance what your question contains, or, in other words, that the best product obtained in the experiment made at Cincinnati was, in my opinion, as good a one as the Tilghman coil apparatus was capable of yielding, and that product, as shown by the analysis made by Dr. Endemann and myself together, contained 81.25 per cent. free fat acid. I know of nothing which would lead me to modify this opinion.

1533 X Q. 236. Do you feel any more confidence in this statement than you did in the statement made by you in answer to question 30, Master's Record, page 277, when you state "I am of the opinion that this one per cent. of lime practically effects a gain of about twenty per cent. in the amount of free fat acid obtained as a final result in this manufacture?"

A. I do not. In either case an adequate demonstration of a different result from that which I supposed possible would, of course, modify my opinion.

X Q. 237. Your conclusion, as expressed on page 277, agreed very well with the experiments you made with the coil apparatus, and I suppose was more or less confounded in these experiments. Was not this the case?

A. It was. It was also founded to some degree on the fact that in examining the record I found only evidence of the failure to obtain good results with this apparatus or evidence as to the obtaining results, which were so described as to leave it quite uncertain as to whether they were good or bad, or at least in nowise prove that they were good.

X Q. 238. You have found, contrary to your expectations, that the efficiency of water in decomposing fats within a given time increases constantly as the pressure increases up to 225 pounds, and your analyses would seem to show, if they show anything, that a decomposition of 95 per cent. of fat is effected by the treatment of fat together with a hundred per cent. of water at 225 pounds for 8½

hours. Why, then, should you suppose that at a pressure of 2,000 pounds it would only be possible to obtain a decomposition of 81.25 per cent. of fat, or 15 per cent. less almost than you know was obtained at a pressure of 225 pounds?

A. Because, in the first place, I know that when the experiment was tried in my own presence, under what I believe to have been as favorable conditions as possible consistent with con-
1534 formity to the directions of the patent, this low result was obtained, because I have read in the Supreme Court record that when this coil apparatus was used, with apparently every effort to secure the best result, years ago, a successful or good result was not obtained, and also because I consider it quite probable that, at a very high pressure, a worse result might be obtained than at a low pressure, since this high pressure would favor that recombination of fat acid and glycerine, which would be the natural explanation for the low result which I observed in the coil experiment at Cincinnati, and which I believe to have been observed elsewhere. In this connection I would cite, in support of the reference I have just made to the probable recombination, an extract from the German edition of Payen's Industrial Chemistry, published in Stuttgardt in 1874, on page 690 of volume 2, and I now produce a translation thereof.

(Said paper was offered in evidence and marked "Def'ts' Exhibit Payen, German edition of 1874.)

X Q. 239. Your observation of the coil apparatus of Messrs. Procter & Gamble, while it was at a lead-melting heat, lasted for but 29 minutes. Is not that so?

A. It is so.

X Q. 240. During this time—this 29 minutes—the coil was leaking badly, was it not?

A. Not that I observed. I did not observe the leaking of the coil until about the time the last sample was taken.

X Q. 241. Then, in giving your answer as to the capacity of the coil at this heat, you have acted on the assumption either that the coil was not leaking during the first part of your observation, or that such a leak would make no difference in the result. What view do you take?

1535 A. The view that the coil was not leaking at the time the sample 8 was taken, or during the time when the earlier samples were; but its leaking at the time that samples 10 and 11 were taken would not, in my opinion, be material.

X Q. 242. Do the analyses which you made of the samples obtained by Mr. Gamble, at a pressure of 225 pounds, indicate any tendency to recombination of glycerine and fatty acid?

A. I think they do, in this sense, that after about 90 per cent. of free fat acid was obtained where the quantity of water, or where the proportion of water was that mentioned in the Tilghman patent, there is an exceedingly slow increase on prolonged treatment, which would seem to indicate such an action as this, checking the further decomposition which one would naturally expect—in other words, a

decomposition equal to 50 per cent. having been obtained in three hours, or of 80 per cent. in 5 hours, it would seem natural that more than 10 per cent. of further decomposition would take place in 3½ or 4½ hours more. I have specially in mind digestions Nos. 2, 3, and 4.

X Q. 243. Referring now to digestion No. 4, for example, we have as against a steady though gradual increase in columns Nos. 2 and 3 no increase at all from the fourth, or, perhaps, from the third to the ninth hour. If your assumption that, because 2 and 3 show a very gradual increase therefore there would seem some ground for supposing a recombination, from the fact that column No. 4 shows absolutely no increase, would be even stronger reason for supposing a recombination in that digestion?

A. It would.

X Q. 244. That does not fit very well with the exhibit which you offered from Payen, does it?

A. Not in all respects. It will be noticed that Payen refers to more than one per cent. of lime, and does not refer to the ex-
1536 tent to which the action of the lime would reach. In digestion 4 we see that the action of the lime had, by the end of the third hour, accomplished as thorough a liberation of the fat acids as was obtained, without lime, at the end of 9½ hours; and, under these circumstances, the relatively small amount of neutral fat left was under a very different condition as regards the possibilities of further decomposition, from the larger amounts present at corresponding times in the digestions Nos. 2 and 3. In other words, as I understand it, in this digestion No. 4, the lime did its entire work, practically, in the first three hours, and then simply served to hold the acid then developed from further change, and the mixture then was practically a mixture of 91 per cent., or more, of acid from which the glycerine had been discharged, with about 9 per cent. of undecomposed fat which, of necessity, would be mechanically protected from contact with the water to a large extent, and in which, therefore, decomposition would of necessity be very slow.

X Q. 245. Do you mean to be understood as saying that, because the decomposion of the fats in digestions 2 and 3 was slow, and because the proportion of fat acid increased with gradually decreasing ratio as the decomposition became more complete, that, therefore, you find any recombination of glycerine and fat acid had taken place?

A. I do not mean, of course, to say that this is positive evidence of a recombination, but that this very slow increase in free acid seems to me to indicate that, while decomposition was going on at certains points in the digester, recombination might be going on at others. I do not intend to adduce this as a demonstration, but as my answer to your original question on this subject, and the question, I think, indicates —. I simply say that I find in this a suggestion as to the possibility of such an action taking place.

1537 X Q. 246. So far as the columns of analyses would indicate, this suggestion could be made with even greater force from the columns 4 and 5 than from the columns 2 and 3, could it not?

A. Not when we take into account the circumstances I have already alluded to, that at the corresponding point in columns 4 and 5, over 90 per cent. of the fat acid has already been liberated from combination with glycerine.

X Q. 247. It would seem to be an obvious proposition, supposing that there be any truth in the hypothesis as to a recombination of glycerine and fat acid, that the more glycerine and the more fat acid present—that is, the richer any mixture was in glycerine and in fat acid, the more likely this combination would take place. Would it not seem so to you?

A. It would, provided those were the only substances present; but if there were a substance present tending to prevent such an action, this might easily modify the result.

X Q. 248. What substance is it which you think might tend to prevent this recombination?

A. The lime.

X Q. 249. What is the foundation of this theory you have mentioned about the recombination of glycerine and fat?

A. The experiments of Berthelot on the synthesis of fats and the observations made as to the difficulty of obtaining complete saponification by the use of water alone.

X Q. 250. Your own experiments have shown that many of the assertions, as to the difficulty of obtaining this saponification, were made under a similar error to that entertained by you when you first stated the supposed impossibility of obtaining anything like a practical decomposition by this process. Were they not?

1538 A. I cannot say, from my present recollection, that my experiments have disproved anything stated by others on this subject.

X Q. 251. Is it not a fact that, so far as your investigations or knowledge goes, this theory of the recombination of glycerine and fat acid rests solely on Berthelot's experiments—I mean, Berthelot, so far as you know, is the only person who has asserted that he has observed the actual synthesis of fats from glycerine and fatty acids?

A. I know of no one else.

X Q. 252. From what source did you derive your information as to Berthelot's experiments?

A. Chiefly from his own article in the Annals de Chimise et de Physique. An abstract of this article from Liebig & Kopp's Year Book is also found in the Exhibit No. 8 of this case.

X Q. 253. You assisted Dr. Endemann in selecting and preparing these exhibits you have stated, I believe?

A. I assisted him in preparing them.

X Q. 254. Why did you not make an exhibit of Berthelot's own article which you say you had personally consulted rather than have the extract from Liebig & Kopp's Year Book?

A. Because I did not select these exhibits, but only assisted Dr. Endemann after he had picked them out at the library in Cincinnati by writing, to his dictation, the translations.

I might say, appropriately in this connection, that when Dr. En-

demann and I were called upon in this case it was expected that testimony would be required in a couple of weeks, and we, therefore, arranged that I should give special attention to getting up apparatus for the experiments under pressure and by distillation with steam, while he looked up the authorities and developed the methods of analysis. Though the giving of testimony was deferred, it was put off from time to time in such a way that we had
1539 no fixed point leading us to modify this arrangement, which will explain why I depended upon him for the authorities as above mentioned.

X Q. 255. The exhibits put in evidence in behalf of the defendants and numbered from 1 to 12, rest solely on the authority of Dr. Endemann then, and are his selections and not yours?

A. In the sense that Dr. Endemann hunted them up, the credit is entirely due to him; in the sense that I assisted in preparing them and approved of them, they are mine. But, of course, as they are, if I recollect right, all German, they essentially rest on Dr. Endemann, who translated them.

X Q. 256. You do not understand German, do you?

A. I do not.

X Q. 257. Therefore you cannot say whether these exhibits were fairly selected from the context?

A. I cannot.

X Q. 258. Therefore they ought to rest solely on Dr. Endemann's authority, with the exception of your accuracy in copying from dictation; is not that so?

A. That is so with this limitation, that in many cases Dr. Endemann translated to me a good deal, more or less, of the context where these exhibits are brief, and I as well as he decided that the portion translated contained all that was material to the subject.

X Q. 259. Please look at Defendant's Exhibit No. 2, relating to Berthelot's experiments with the synthesis of fats, and state whether you assume any responsibility for the omission of the immediate context of the passage therein translated.

A. I cannot do so, because I cannot at this time recollect anything in reference to this particular passage.
1540 In the case of Exhibit 8, which is the abstract of Berthelot's paper, Dr. Endemann read to me, I think, the entire article, and we both concluded that the portion translated comprises everything that was of importance in reference to the case.

X Q. 260. How does the Defendant's Exhibit No. 2 agree with Berthelot's description of his experiments in his original paper?

A. (Witness reads over the French publication.) In the first place, this Exhibit No. 2 is an attempt to condense into a sentence of six lines something of the results of an investigation covering nine or ten pages in the original article, and states, as an almost necessary consequence, only crudely the results to which it refers. It, moreover, states, as appears from its own language, a deduction not contained in the original article, but only founded on the statements of that article. Thus, for example, Exhibit 2 states that if neutral fats at a certain temperature are decomposed by water into fatty acids

and glycerine at a lower temperature, these products of decomposition may reunite to produce neutral fats. Now, Berthelot's article only states that at temperatures ranging from 200° to 270° (which temperatures are lower than those at which neutral fat is decomposed by superheated steam into fat acid and glycerine, and also lower than the temperature mentioned in the Tilghman patent), fat acids and glycerine will recombine to form neutral fats; but I do not find that Berthelot, in his article, makes any connection between this fact and the other well-known one that, as I have already said, at the higher temperatures the neutral fats are decomposed. Defendant's Exhibit 2, therefore, I should regard not as an abstract of Barthelot's article, but as a statement of a conclusion founded on a combination of well-known facts with the substance of Berthelot's article.

1541 X Q. 261. Does Berthelot in his article assert that he made tri-stearine or ordinary neutral fat by heating together glycerine and fatty acids?

A. Not directly. He first prepared mono-stearine by heating together fatty acids and glycerine, and then making a mixture of this mono-stearine with a further quantity of stearic acid, and heating these together again he obtained the tri-stearine, which he considered identical with the stearine found in nature.

X Q. 262. Do you understand from Berthelot's article that he used in the experiments he describes a watery solution of glycerine such as exists in digesters like the defendants after the operation has been carried on for some time?

A. I do not.

X Q. 263. What he used was pure, concentrated glycerine, was it not?

A. I have no doubt that it was, though not probably anhydrous glycerine. It would be obvious to chemists that it is what we call and would buy as concentrated glycerine.

X Q. 264. I would like to call your attention now to an answer made by you to the question put by the master on page 266 of the master's record. You having said that Dr. Endemann's analysis of a certain sample showed 84 per cent. of free fatty acid in the product, the master asked you question 19: "That is the percentage of the product in all cases?" and you answered, "Yes, sir; in all cases." What did you mean by this answer?

A. I think the answer would be perfectly clear as it stands if the word "product," where used by the master and by myself, were put in italics; but, to explain independently of this, the question asked by the master was, as I believe, directed to this point, did I mean 84 per cent. of the product or 84 per cent. of the material used? and I answered 84 per cent. of the product, meaning not that

1542 84 per cent. of the material used was free fatty acid, but 84 per cent. of the product obtained. This question and answer bears, of course, upon the possibility of obtaining more than 95 to 96 per cent. of free fat acid from any fat.

X Q. 265. Both you and Dr. Endemann have cited numerous publications in which the word "saponification" is used to denote a

decomposition of neutral fats by processes which did not result in the formation of a soap. What bearing have these exhibits on any questions at issue in this case?

A. They have this bearing. They show that at the date of the Tilghman patent, as well as since, any one skilled in the art would know that this term "saponification" did not mean the production of a soap, neutral or otherwise, but meant the decomposition of fat into fat acid and glycerine. Therefore, such a person reading the directions in the Roret exhibit would understand that the amount of lime to be added sufficient for saponification was the amount of lime sufficient to obtain this decomposition, not the amount of lime sufficient to produce a soap.

X Q. 266. Do you mean to be seriously understood as asserting that the term "saponification," at the time of the Tilghman patent, was not used to describe a process in which a soap was made?

A. It was used to describe not only a process in which a soap was made, but other processes in which no soap was made, and therefore did not by its use necessarily involve the making of a soap.

X Q. 267. Where the term was used, then, you would have to examine the context to find out whether the writer, by "saponification," meant making a soap or making a decomposition by some other method?

A. I should not quite agree with that, because one skilled in the art might be instructed beyond the words of a statement, if that statement admitted in the then use of language of an interpretation which went beyond the knowledge of the original writer. Men sometimes build better than they know.

Adjourned to July 31st, 1883, at 10 a. m.

1543 Meeting at Spring Lake, N. J., July 31st, 1883, at 10 a. m.

(Master and counsel present as before.)

Cross-examination of HENRY MORTON continued.

By Mr. CHAMBERS:

X Q. 268. Do you mean to be understood in your last answer as asserting that it is impossible in any case where the word "saponification" is used to ascertain, from the context of the article, whether the writer intended by that word to describe a process by which a soap was made or a process in which fat was decomposed by some other method?

A. I do not. For instance, the words "sulphuric acid saponification" would indicate, without any ambiguity, that sulphuric acid was the agent used to secure saponification, and, similarly, the words "lime saponification" would indicate that lime was the agent used to secure saponification, and so on.

X Q. 269. What processes for decomposing fats into fatty acids and glycerine were known at the date of the Tilghman patent?

A. Saponification by bases, such as lime, lead, etc., by acids; such as by sulphuric acid, by steam, and by fermentation.

X Q. 270. So far as your investigations show, to which of these processes had the term "saponification" been applied prior to the Tilghman patent?

A. As far as I understand, to all of them.

Q. 271. Where the term "lime saponification" is used prior to the Tilghman patent, what do you understand to have been the product of the process so described?

A. A product consisting of various amounts of free fat acid, lime soap, glycerine, and neutral fat, and, in some cases, an excess of lime.

1544 X Q. 272. What authority can you give for your statement that you understand the product of this process to have contained any free fat acid?

A. I find no authority in which any statement is made as to the composition of the product where that composition contained free fat acid. All I find in the way of authority as to this is in directions for producing a product which, from the conditions of the case, would, as I believe, contain free fat acid.

X Q. 273. What authority or publication contains a description of a process which you understand will produce free fat acid by the use of lime?

A. The article in Roret's Encyclopedia, found in the Supreme Court record, on pages 474 and 5.

X Q. 274. Please refer to that exhibit and quote the words which describe or indicate that any free fat acid was produced by the process described there.

A. I have not said that this reference contained any such statement, but that it described a process which, when carried out, would produce a product which we now know would contain free fat acid.

X Q. 275. Do you know anything about the article in Roret from which the exhibit referred to is an extract?

A. Only what is said about it in the Supreme Court record; that is to say, the exhibit to which I have referred and testimony about it, chiefly, I think, by Professor Booth. I have not read the entire article in the original, but I have read all that is translated, I believe, in the record.

X Q. 276. What do you find in the description of the product of this process in the exhibit which indicates to you, as a chemist, that it contained any free fat acid?

A. I do not find any description of a product in this exhibit which would enable me, as a chemist, to form any opinion as to whether it did or did not contain any free fat acid.

X Q. 277. Have you ever seen any lime soap?

1545 A. I have.

X Q. 278. When and where?

A. At Cincinnati and in my own laboratory.

X Q. 279. Is it a solid or a liquid substance?

A. When cold it is solid; when hot it is semi-solid or plastic.

X Q. 280. Please look at the Roret publication which I now hand you, and translate the sentence which immediately precedes the

extract from the publication which is printed as an exhibit in the Supreme Court record.

A. (Reading from a book:) "The quantity of lime necessary to saponify 100 kilogrammes of tallow may be fixed, without fear, at 14 kilogrammes."

X Q. 281. What is the nature of the product obtained by treating tallow with 14 per cent. of lime, together with water?

A. This would depend very much upon the method of treatment. If the materials were mixed and treated under atmospheric pressure only the most perfect reaction would produce a neutral lime soap and glycerine, with which products there would be mixed an excess of lime. If the process were not carried out for a sufficient time, or under other conditions requisite for producing the best effect, a portion of the fat would be left unchanged, and there would be, of course, a greater excess of lime. If the process were conducted in a closed vessel under pressure, and the method of mixing the materials was imperfect, we might then have in the product free fat acid, some lime soap, and a great excess of lime, together with glycerine.

X Q. 282. Have you any authority for your statement that free fat acid is produced in a process where fat is treated, together with 14 per cent. of lime, in a closed vessel and under pressure?

A. I know of no authority where there is specifically
1546 made this statement, but I do not consider that any authority is needed, since it is manifest that under the conditions I have mentioned such must be the result—that is to say, if the method of mixing is imperfect a large part of the lime would lie at the bottom of the closed vessel in which the material was treated, and the contents of the vessel would then be precisely under the same conditions as though the amount of lime present were much less than that required to form a neutral lime soap with the fat acid present. Under these conditions every-day experience teaches us that the product formed would contaid free fat acid, and there is abundant evidence as to this also in the Supreme Court record.

X Q. 283. Do you not find in this exhibit, as well as in every other description of the lime-saponification process, directions to the effect that an intimate mixture shall be kept up, or descriptions of devices for causing such an intimate mixture?

A. I do not. I find in this exhibit the following only: "The cover has in its center a stuffing-box, through which passes a stirring-rod with a cross-piece of wood at its lower end;" and, further on: "The boiler is then closed and the liquid stirred at short intervals by raising and lowering the stirring-rod or plunger." Such an apparatus, used in this way, I do not think would by any means produce a thorough mixture. The oil would float on the top, the water would form a layer below, and a considerable portion of the lime would settle at the bottom.

X Q. 284. You have omitted to read from the exhibit what immediately follows your last quotation, to wit: "This operation is continued until the thermometer marks 277 degrees Fahrenheit and 136 degrees centigrade; as the whole mass becomes stiff after a

certain time, agitation is no longer practicable." Does not this indicate to you that the agitation described was sufficiently
1547 thorough and sufficiently long continued to result in the formation of a hard lime soap?

A. It does not, if by this you mean that a hard lime soap was the only product. On the contrary, it indicates to me that a stiff layer consisting of lime soap and free fat acid was formed on the top of the water, and that this is the material or product referred to.

X Q. 285. Have you ascertained by experiment that there is any free fat acid in a product obtained in the manner described in the exhibit?

A. I have not.

X Q. 286. Have you ever experimented with any process in which fat was treated with fourteen per cent. of lime?

A. I have.

X Q. 287. Do you know whether the process described in the exhibit ever went into practical use?

A. I do not.

X Q. 288. It is stated in the exhibit that it was believed for a long time that lime saponification could only be effected in closed boilers, and the author continues that he does not know why this process had been abandoned. Do you know why it was abandoned?

A. No; nor do I even know that the author is correct in that statement. My own impression is that the saponification in open vessels was the earliest of all.

X Q. 289. You know, do you not, that this same DeMilly mentioned in the exhibit, after the issue of Mr. Tilghman's patent, took out another patent, claiming as a new invention the process of treating fat in closed digesters with a quantity of lime less than sufficient to completely saponify or make neutral lime soap of the fat treated?

(Objected to as incompetent.)

1548 A. I do not know anything about this of my own knowledge, but it is quite possible that such patent does exist and may be referred to in the record, but my memory does not enable me to say positively whether I have found it there or not.

X Q. 290. What knowledge have you as to the perfection of the decomposition obtained by the old lime-saponification process?

A. I have no knowledge of my own, as I have never carried on that process under such conditions as would enable me to feel sure that I had secured a result equal to that which was obtained in the commercial working of the process.

X Q. 291. What results did you obtain?

A. In the only experiment in which I examined the results, which was one made with 14 per cent. of lime on a small scale in my own laboratory, I obtained only 70 per cent. of free fat acids, but I had there no method of securing agitation or mixture beyond that of allowing steam from a small boiler to bubble through the mixture from the end of a glass tube and an occasional stirring by hand. My recollection is that the operation was carried on for six hours.

X Q. 292. Did you ever examine any of the lime soap made by the defendants?

A. I never did.

X Q. 293. Were you informed that the defendants did make some experiments with the manufacture of lime soap since the reference of this case to the master?

A. I was not.

X Q. 294. You have stated during your examination that "a product containing 92 per cent. of free fat acid was notably inferior in purity, and therefore manifestly less valuable, than that obtained by older processes." Did you mean to include lime saponification in older processes you speak of?

A. I did.

1549 X Q. 295. And yet the only examination you had made of lime soap showed that by this method but 70 per cent. of fatty acid was obtained in the product?

A. In the first place, I do not consider that your question correctly states the facts. I have never asserted that I have made any test whatever upon the product of the old lime-saponification process, because that process is only used, as I understand it, when it is carried out thoroughly and under favorable conditions. I do not regard my imperfect experiment in my laboratory and the product there obtained as in any way representing the product of the old lime-saponification process; therefore this imperfect experiment has nothing to do, and should have nothing to do, with my conclusion as to the relative purity of the product obtained with the old lime-saponification process. My opinion as to that is founded upon what I have read in the testimony in this case and in the Supreme Court record and elsewhere, from which I have reached the conclusion that, as far as purity of product went, the old lime-saponification process left nothing to be desired; that the other processes which have been introduced in no case claimed to effect or effected the production of a purer product, but only claimed to secure greater economy in the production of a product which, while possibly less pure even, might be pure enough for practical use under certain conditions.

X Q. 296. You made a positive statement that a product containing 92 per cent. of free fat acid was notably inferior in purity to that obtained by the lime process. State any authority which warrants you in asserting that a product of greater purity than 92 per cent. was produced by the old lime-saponification process.

A. I cannot now recall the statements from which I have formed this opinion, but have no doubt that they exist in the record
1550 in this case and in the Supreme Court record, and therefore can be found when they are needed.

X Q. 297. I think you need them now to sustain what you have asserted to be a matter of fact. If you have recollection enough of them to warrant you in stating this fact under oath, as you have done, it seems to me that your recollection should at least go to the general substance of the statement, even if you cannot find it in the record. State, therefore, what your recollection is as to the tes-

timony on which you found your statement, and also how much above 92 per cent. this noticeably pure product was.

A. My recollection is that the statement or statements to which I refer were to the effect that the product of the lime-saponification process showed a full equivalent of free fat acid, which would be, approximately, eight per cent. above 92. per cent.

X Q. 298. If any such statement were contained in any part of the record, and were founded on an analysis of the product, is it not the fact that the only method of analysis used by any of the witnesses whose testimony is reported in the Supreme Court record was a method which you have yourself pronounced to be absolutely unreliable?

A. To the best of my present recollection this would not be so. If I am not mistaken Prof. J. Lawrence Smith used a method of analysis quite different from the method upon which I have commented, the method commented upon by me being simply the method used by complainant's experts.

X Q. 299. Do you mean to assert that none of the defendants' expert witnesses used this method of analysis?

A. I do not.

X Q. 300. Are we to understand, then, that Mr. Smith, by his method of analysis, ascertained that the old lime-saponification product gave a perfectly decomposed result?

1551 A. I do not recollect.

X Q. 301. You have absolutely no recollection, then, as to whose authority your assumption rests on, or by what method they arrived at the conclusion which you state you think they arrived at?

A. I cannot at this time recall any of these details, but now, as at the time of giving the testimony you refer to, there is in my mind a very strong impression that this was an accepted fact, nowheres called in question.

In reference to this question of the complete reaction or complete saponification in the old lime process I would refer to the article on stearic acid in a work entitled Cooley's Cyclopædia of Practical Receipts and Collateral Information on the Arts, Manufactures, Professions, and Trades, published in New York by D. Appleton & Co., 1880, volume 2, pages 1556 and 1557, in which, on page 1556, section 3, I find as follows: "(Commercial.) Ordinary tallow is boiled in large wooden vessels, by means of high-pressure steam, with about sixteen per cent. of hydrate of lime (equivalent to eleven per cent. of pure lime), for three or four hours, or until the combination is complete and an earthy soap is formed, when the whole is allowed to cool; the product (stearate of lime) is then transferred to another wooden vessel and decomposed by adding to it four parts of oil vitriol (diluted with water) for every three parts of slaked lime previously employed, the action being promoted by steam, heat, and brisk agitation; after repose the liberated fat is decanted from the sediment (sulphate of lime) and water, and is then well washed with water and by blowing steam into it; it is next allowed to cool, when it is reduced to shavings by means of a number of knives worked by

machinery, and in this divided state is placed in canvas bags." Here, manifestly, the action is stated to be complete, and the product to be stearate of lime.

1552 (A copy of the article in question is offered in evidence, and marked "Defts' Exhibit Cooley Article.")

Similar statements to this will be found, I think, in any ordinary text book on chemistry, and as I happen to have Fowne's Chemistry, published in London, in 1868, with me, I will read a passage from that on page 734: "On the large scale, impure stearic acid is prepared for the manufacture of stearine candles by saponifying some of the harder fats, generally with lime. The resulting lime soap, decomposed by the sulphuric acid, yields a mixture of fatty acids, which are pressed first in the cold and afterward at a higher temperature, in order to separate the oleic acid from the less fusible palmitic and stearic acids." Here, again, the product is alluded to as fat acid, pure and simple, the impurity mentioned at the beginning of the quotation being manifestly the presence of a portion of palmitic and oleic acids in the stearic.

X Q. 302. Do you mean to be understood as seriously asserting that the passages you have quoted contain any assertion which warrants you, as a chemist, in citing them as proof that the product obtained contained more than 92 per cent. of free fat acid?

A. I undoubtedly do, as chemical works, such as Fowne's Chemistry, make their statements with precision and accuracy, and when they state that a product is obtained, and say nothing about the presence of impurities or other materials, which, if present, would seriously modify the character of the products, we may feel, I think, entirely confident that they intend to state, as they manifestly imply, that the products are pure and do not contain such impurities or foreign matter.

X Q. 303. Then, whenever you see in a publication a refer-
1553 ence to a commercial product by its chemical name, you are willing to assert that the author or compiler means to describe a chemically pure product, whether as a matter of fact the ordinary commercial product of which he speaks is chemically pure or not?

A. Not exactly that, but I mean to assert that when a chemical writer of good standing asserts that a product is a pure substance, naming it, he means what he says.

X Q. 304. Do you find in either of the publications referred to by you an assertion that the product spoken of is a pure product?

A. I find it in Fowne's Chemistry, and asserted in the following way: On page 733, at the beginning of the article on stearic acid, there is given immediately after those words the chemical formula for stearic acid, which indicates of course that substance in a chemically pure state, and I find nothing to limit this title and this chemical formula in what follows, but, on the contrary, I find a method given for producing chemically pure stearic acid, and then come to the sentence which I have already quoted, which, as I consider it, shows that the assertion and meaning of that author was that pure

fat acids, consisting essentially of stearic acid, are produced on a large scale in the manufacture of candles by the lime-saponification process. Moreover, in the same paragraph the author goes on to say: "Another method, applied chiefly to palm oil, consists in decomposing the fat with superheated steam, as described under "Glycerine," page 663. A third method consists in treating the fat with sulphuric acid and distilling the product." Now, I have already quoted, in earlier parts of my testimony, several authors of high standing, who assert that products obtained by both these processes last named would be pure fat acids. I have no manner of
1554 doubt that equivalent statements to those of Fowne would be obtained by reference to any standard work on chemistry.

X Q. 305. I find in the continuation of the section of Cooley's Practical Receipts, from which you quoted, the following statement: "This product is a more or less impure mixture of stearic acid and other fatty bodies," etc., and I find further in the same article the following statement: "In the case of the alkali this must either be used in quantities much greater than theory requires, or else be heated under great pressure at the risk of giving rise to an explosion." Would this not indicate to you that the writer of the article, whoever he may be, so far from intending to be understood as describing a chemically pure product, intended very distinctly to notify the reader that the product obtained by this method, unless a great excess of lime were used, would be very decidedly impure and not thoroughly decomposed?

A. As to the first passage referred to by you it should be noticed that the article in question is headed "Stearic Acid," and therefore that all through stearic acid is the body referred to; hence, when the statement is made, "This product is a more or less impure mixture of stearic acid and other fatty bodies, particularly the so-called margaric acid," it seems to me perfectly plain that the impurity alluded to is the presence of other fatty acids, and that alone.

Your second reference follows a discussion of Prof. Bock's method, where the fatty matter is first treated, not under pressure, with a small amount of sulphuric acid, after which the neutral fat is placed in open tanks with water, by which, after the expiration of several hours, it is stated to be decomposed. In comparing this process with the older ones the author states in the passage which you have quoted his opinion that where lime was used either an excessive quantity or else pressure would be required to obtain com-
1555 plete saponification. Now, it is well known that in the old lime-saponification process lime in considerable excess beyond the theoretical quantity was used, and, therefore, I find nothing in this reference, even aside from its detached character and disconnection with the older statement of the same author, which would in any way limit or qualify that statement or the deductions I have drawn from it.

X Q. 306. We are to understand then that you honestly believe and state under oath that from a reading of this article you understand the writer to intend to state that, by the process described, an

absolutely pure fatty acid is obtained without the least admixture with undecomposed neutral fat?

A. The terms "absolute" and "without the least" carry the idea a little beyond my notion or understanding of the article, which is that the author intends a product which should contain no appreciable amount of anything but free fat acids, and, to give this a numerical shape, I should say that I understand by this that the article indicated would contain no less than 99 per cent. of free fat acid, and be probably purer than that—one per cent. being a quantity perhaps too small to be recognized without special means of investigation. I think that this author, Fowne, and the chemical literature at large place this conclusion as to the purity of the product at least in such a position that the burden of proof lies not on those who accept the statements found in such authors but on those who call them in question.

X Q. 307. On looking over the book produced by you, Cooley's Practical Suggestions, I find it to contain articles on pie, jam, jelly, tarts, pills, tape-worms, whooping cough, and, in fact, on almost every imaginable subject. Is this the kind of work that chemists of reputation should go to when asked for authority on assertions which they make?

A. Not when they have a library at command; but when,
1556 at a distance from all supply of standard authorities, their chemical library is reduced to this book and Fowne's chemistry, they would, I think, with propriety give this for what it is worth.

Hearing, July 31st, 1883.

Afternoon Session.

Cross-examination of HENRY MORTON continued:

Witness desires to state that, when making his last answer, he had momentarily forgotten that he had with him also Morfit's Applied Chemistry, Soap, and Candles, to which he would refer in further confirmation of what he has already said as to the universal acceptance by writers on this subject of the fact that by the lime saponification a pure fatty acid product was produced. The description of the process contained in this work is a lengthy one, beginning on page 439 and continuing at least to 453, but without, of course, quoting or introducing the whole of this matter, that which is in point will be briefly referred to. On page 439, in a note, after the description in the text of the ordinary process, allusion is made to the saponification in a closed vessel, under pressure, with a reduced quantity of lime, in these words: "This principle has already been successfully applied in the manufacture of stearic-acid candles by lime, and with great economy of time and material, as it effects a saving of lime, and, consequently, also of the acid required for the subsequent decomposition of the lime soap." Nothing is here said as to any increase in purity of the product which, through-
1557 out, in numerous places, is alluded to as fat acid. At page 452, under the heading "Purification of the Block," I find

as follows: "The pressed cakes on being emptied from the bags are thrown into a very clean lead-lined cedar tub, and the whole batch melted by a current of steam. Five pounds of sulphuric acid, diluted with ten pounds of water, are then gradually added to the melted fat block, so as to withdraw and precipitate any remaining alkali or other impurity." This is the only reference to impurity, and, I think, clearly implies that none other was present except lime, or other like base, which would be removed by sulphuric acid used in the manner described. Such a use of sulphuric acid would in no wise remove neutral fat if present. The work which I have cited is one specially devoted to the manufacture of soap and candles, and the absence of any reference whatever in it, in its lengthy description of this process, to the presence of an impurity in the shape of neutral fat would, I think, amount to very strong presumptive evidence that the product obtained was a practically pure fat acid.

X Q. 308. I have no doubt you are quite correct in your last statement, and agree with you in thinking that, where the authors you have quoted speak of the product as being fat acid, they mean, as you say, a practically pure fat acid, or what is known as fat acid in the trade. My questions to you, however, are put to you in your character as a chemical expert, and were directed toward ascertaining whether you had thought it worth your while to acquaint yourself with what the actual composition of the ordinary commercial fat acid was. This, as I now understand you, you have never done yourself, nor have you ascertained that anybody else has done it, as applied to the product of the old lime-saponification process. Is this so?

A. In the first place you misunderstand my use of the words
1558 "practically pure." By "practically pure" I mean simply to distinguish from chemically pure. By "chemically pure" we mean something that has absolutely no trace of any substance in it but the one named, and, of course, I do not suppose that the product of any commercial process would ever be in this condition, but what I have said, and what I consider the authorities quoted support me in saying, is that this product of the old lime saponification was not only commercially pure but thoroughly pure, if that term will suit better—in other words, was as pure as it could be short of being chemically pure. Aside from these authorities it is true that I have not myself made an analysis of the product obtained by the old lime-saponification process, nor do I at this time know of anyone else who has made such an analysis.

X Q. 309. No one of the writers to whom you have referred assert that they have analyzed the product of the process which they have described or pretend to give the result of any analysis, do they?

A. They do not, as far as I recollect.

X Q. 310. The only analysis then of which you have the least knowledge gave but 70 per cent. of fat acid in a product obtained by treating fat with fourteen per cent. of lime?

A. As I have already stated I have no knowledge of any analysis of the product of the old lime-saponification process. It is, however,

also true that I made an analysis of a fat mixture obtained by a treatment such as stated of fat with fourteen per cent. of lime with the result you have stated.

X Q. 311. When did you make the experiment in which you obtained this product?

A. Some time after my return from Cincinnati and prior to my resumption of my testimony in New York.

X Q. 312. What quantity of fat did you use in this experiment?

A. About one pound, as far as I can recollect.

1559 X Q. 313. What was your object in making the experiment?

A. To inform myself as to the rapidity of the action which would take place when lime, water, and fat were heated together as bearing upon previous hypothetical statements which I had made on that subject.

X Q. 314. As I understand you, you introduced steam into the mixture of lime, fat, and water to cause ebullition throughout the contents of your vessel?

A. To cause agitation throughout the contents; yes.

X Q. 315. You also stirred it from time to time?

A. I did.

X Q. 316. How much water did you have in your vessel?

A. I do not now recollect the quantity, but it was so large a one that there was a great deal of water left at the end of the operation besides that which had in any way combined or mixed with the soap and fat. My impression is that the amount of water was probably double the bulk of the fat.

X Q. 317. From your description you seem to have had in this experiment all the conditions of what is known as the old lime-saponification process. I understand, however, that this is not your view. Please state what conditions of the old process were lacking in your experiment.

A. The conditions of thorough mechanical mixture. In my experiment the steam was passed from the end of a single tube, and as soon as the reaction began so that the soapy mixture thickened this steam rose almost in a single line through the material and would have done almost nothing toward stirring or mingling it had I not from time to time disturbed it or moved the contents of the vessel with a stirring rod; but, as I was busy about other things, this

1560 was only done occasionally, my object at the time not being to effect a complete saponification, but only to see what result would easily and directly be attained. The result of this experiment proved to me very conclusively that the reaction of lime, fat, and water was a very slow one where there was no added temperature and corresponding pressure.

X Q. 318. What was the size and shape of the vessel you used in this experiment?

A. It was what is known as a miner's cup, I should think, holding a little over a quart, and very much the shape of an ordinary quart measure, made of granite wear—that is, sheet-iron coated with enamel.

X Q. 319. Was this vessel entirely full of the material treated?

A. It was not.

X Q. 320. Must you not be under some mistake in stating that your vessel held but a quart, and that you put into it two pounds of water and one pound of fat?

A. I said that it held over a quart; but I may be mistaken as to the size of the vessel. It is a regular article of commerce under the name I have given it, which can be bought at almost any hardware store, I think, and it may be that its capacity was nearer two quarts than one.

X Q. 321. What was the diameter of the steam tube you introduced into this vessel?

A. About a quarter of an inch inside diameter—about a quarter to an eighth. It was an ordinary piece of glass tubing.

X Q. 322. Referring to the experiments with the so-called Tilghman coil which you witnessed in Cincinnati, I understand you to have stated that you did not know the apparatus was leaking when the first of the samples was taken at lead-melting heat. Do you wish to modify this statement, or are we to take it as absolutely true?

1561 A. The only way in which I would modify it is by saying that when the leak did begin there was no difficulty whatever in recognizing the fact, and that therefore I feel very confident not only that I did not notice any leak at that time, but that no leak of any substantial character—I mean no leak amounting to anything—existed until close upon the end of the operation. The remark was made by those in attendance that, the apparatus having leaked before, it was remarkable that it was closed again and held so tight during the previous stages

X Q. 323. You were not told, though, and did not know, that the apparatus was broken inside of the furnace and was leaking there?

A. I was told that it was broken in a previous use, but, as I have said, I was told at the time that that break had closed, and that it was practically tight during these experiments until the end, when the leak occurred, and it was manifest to everybody in the place that such a leak was producing its effect.

X Q. 324. Manifest by——

A. The escape of smoke and very irritating vapors from the furnace.

X Q. 325. The leak, then, which you observed did not occur in the pipes outside of the furnace, but in the furnace?

A. I did not myself directly observe any leak in the sense of being able myself to locate it, but just at the end of the operation there was the violent escape of fumes and smoke that I have described, which I was informed was the result of a leak.

X Q. 326. Did you see where these fumes and smoke came from?

A. Only in the general way that they came from the direction of the furnace. I was close to the outlet of the cooling appa-

1562 ratus, which was at some little distance from the furnace, but within sight of it.

X Q. 327. At what hour did you notice this leakage?

A. I could only fix the time as being a very few minutes before the close of the operation—I should say two or three minutes.

X Q. 328. Was it after the last sample was taken that you noticed it, or before?

A. I think just before. It was practically coincident with taking the last sample, as far as I now recollect.

X Q. 329. In giving your testimony, then, about the coil apparatus as you saw it in Cincinnati, you were under the impression that the apparatus was not leaking until the very end of the experiment?

A. That was and is my impression as to any leakage of a substantial character. By "substantial" I mean, of course, any leakage which would affect the rate of flow of the mixture through the coils to an appreciable degree.

X Q. 330. Can you state the percentage of water present in the best quality of ordinary concentrated glycerine?

A. I cannot, with certainty, but think it is under five per cent.

X Q. 331. (By the MASTER): What is the specific gravity of concentrated glycerine?

A. From 1.24 to 1.27, about, according to its degree of concentration. Assuming water to be 1,000, these numbers would be 1,240 to 1,270.

X Q. 332. If you take a pound of glycerine water of a strength of 102 specific gravity and dilute it with a pound of water, so as to make a glycerine solution of a quart in volume, would not the specific gravity of the quart solution be substantially 101?

A. It would, the temperature, of course, being constant.

1563 X Q. 333. You have referred to the article by Pelouze, printed on pages 908 to 910 of the Supreme Court record. Do you wish to be understood as agreeing with the statements and conclusions made by Pelouze in that article?

A. I agree with the statement of facts contained in this article, but I cannot say I agree with all the conclusions. I should agree with the conclusion that soap has a very marked influence in accelerating the saponification of a mixture of fat and water under the influence of heat and pressure, but I should not agree as to the hypothetical steps by which that general result is brought about, my own impression being, as I have stated earlier in my testimony, that the soap, in the presence of excess of fat, forms an acid soap, which is decomposed in the presence of excess of water.

X Q. 334. I find in the article by Pelouze the following statement: "I have, besides, assured myself that at a temperature of 165° (centigrade) water does not act upon oils." This statement your own experiments show to be false, do they not?

A. I do not feel prepared to say that, because I think Pelouze is here speaking of olive oil, and I have made no experiments on olive oil, and it is moreover, I think, admitted that oleine, which constitutes the main parts of oils, such as olive oil and the like, is more difficult to decompose than palmatine or stearine.

X Q. 335. If this statement has any reference to tallow, then, it is untrue, is it not?

A. It is.

(Cross-examination ended. No redirect.)

(Signed) HENRY MORTON.

1564 JAMES N. GAMBLE was next recalled for further cross-examination.

By Mr. CHAMBERS:

X Q. What quantity of coal is required to provide steam and heat sufficient to run one of your digesters for one charge?

A. For each charge of from 6,500 to 7,000 pounds there would be required for heating the digester from sixteen to twenty-two bushels, of 72 pounds each, of what we call boat-slack—mixed nut and slack—bituminous coal, the price of which would be from 7¾ to 9 cents a bushel.

Adjourned to August 1, 1883, at 10 a. m., same place.

Meeting July 3rd, 1883—10 a. m.

Master and counsel present as before.

GUSTAVE JANSSEN, being duly sworn on behalf of defendants, was examined [by] Mr. PARKINSON, and testified:

Q. 1. State your name, age, residence, and occupation.

A. My name is Gustave Janssen; my age is 58 years; residence, New York; occupation, glycerine manufacturer.

Q. 2. What experience, if any, have you had in the manufacture of candles from fat acids?

A. I went into that business in 1855, as a partner in a factory in Brussels, Belgium. At that time we were working with the old process, which is called open-tub lime process—that is to say, using 14 per cent. of lime and 28 per cent. of acid.

Q. 3. What was the name of that company that you went into and in what capacity were you connected with it?

1565 A. The name was Derouboix, Jenar & Co. I was a partner, with 40 per cent. interest in the whole business. The capacity of the factory at that time was very small, producing only three thousand candles a day.

Q. 4. Was that small in comparison with other establishments at that time, or simply small in comparison with the capacity in later days?

A. It was the largest in Belgium, anyhow, at that time, but was small as compared with the DeMilly factory; but we soon increased it—I think between three and four years—when we produced 15,000 pounds a day; and then, in 1865 or 1866, about that time, we increased it up to 30,000 pounds a day.

Q. 5. How long did you continue your connection with this company?

A. Up to 1870.

Q. 6. Were you an active partner?

A. An active partner, especially in the manufacturing.

Q. 7. What business did you personally do in connection with the manufacturing?

A. Superintended all the manufacturing, from the grease to the candle; everything, in all that was going on in the factory; superintended all the works.

Q. 8. When did you first try any other process than the open-tub lime process?

A. It was about 1860, as far as I can recollect, that we made the first trial with the copper digester.

Q. 9. What process was this called?

A. We tried it with water alone; we called it the "water process"—that is to say, without anything with water—without lime or anything at all; that was our first trial.

Q. 10. Describe this process.

A. We put in a digester about 20 or 25 per cent. of water, as compared with the quantity of fat by weight, and then we made,
1566 I recollect, fire—we had no boiler—put the fire direct under the digester, and we worked up to 225 and 230 pounds pressure. We made many trials to try to make it as we did before, but we could not succed in making any, and, after three months—perhaps six months; cannot say exactly—we had to give it up, not being able to make any good candles out of that process.

Q. 11. In this process you speak of did you use any lime?

A. No.

Q. 12. Was there any provision for circulation in this?

A. Yes, we made, outside of the apparatus, connected at the top and bottom, a big coil, making many spiral turns, and about four inches in diameter; and we had all the time cold water running on that coil, in order to force circulation, to make a difference of temperature between the temperature of the digester and that of the coil, and that forced a circulation; and, besides that, we had put some little faucets at different places of that coil, to see whether the circulation was established, and we noticed all the time that it was running, all the time with the water and tallow—they were mixed—and we run sometimes as much as 24 hours one operation to see whether the time would make the saponification; but we never made good goods that would answer our purpose—good fat acid, we called it—liable to be easily pressed.

Q. 13. After you gave up this process last referred to, how did you continue to manufacture your fat acid?

A. As we used a great deal of palm oil in our factory we only made part of our fat acid through the digester—that is to say, we only treated the tallow through the digester and not the palm oil, and we used in that digester, which was the same I have described,
two per cent. of lime of the quantity of grease, put two per
1567 cent. of lime of the quantity of grease in the digester with 25 per cent of water, as compared with the quantity of grease with water—that is, 250 pounds of water to 1,000 pounds of grease and 20 pounds of lime—and that gave us a very satisfactory pro-

duct—very good fat acid, I mean. We worked at that time at 140 pounds pressure, and the operation only lasted seven hours, and that gave us the same quantity of glycerine as we had by the old process—open-tub process we called it. After using the same apparatus for some time we gave it up altogether for a time, because we found a way to saponify the tallow and the palm oil in a very short time with acid without any lime or anything of the kind, no apparatus, except an open tub, but we had to distill that good after being worked with acid to make it white, because, when you used sulphuric acid with grease or palm oil, you get it black or a very dark brown, and then it must come through the still to have it white again. We used that process, without the digester at all, for a long time. We did not see the benefit of the digester. We gave up the digester altogether to use only the open tub with acid. I don't know how long, for I couldn't tell exactly—more than several weeks, may be for two or three years—can't tell exactly now; for years we gave it up; for two reasons, because our capacity was increasing so much that we had to put much more apparatus to make the quantity that was required, and those apparatus were very expensive, we thought, to give them up in order to work with open tubs with acid. We gave up the digester, I think, in 1865 or 1866, because we had to put so much more apparatus to follow our capacity; we had too much capacity; it would make too much expense in the case of the apparatus, and at that time the glycerine was not wanted, and that is a reason for which even we took the open tub with acid, because we had no care for the glycerine, no value at that time.

1568 Q. 14. When did you begin to use the digester with the two per cent. of lime; was it just as soon as you stopped using it with the water alone?

A. After we saw that we could not succed with water, after many trials, then we went right away on the same apparatus with lime, with the same digester. We gave it up, as I told you, on account of the glycerine being — no value and the open tubs being much quicker for the purpose. At that time, I recollect now, we were interested in a factory in the city of Cologne, Germany, a partner, and we sent that apparatus to Cologne, there to be worked with lime, that same apparatus, and there they worked it all the time for five, six, or seven years until they wound up. Ourselves, we managed it there because we were interested there.

Q. 15. After you stopped using this digester with water alone, how was most of your tallow saponified for the next five or six years?

A. Immediately after the experiment with water we tried lime, and then open tubs with acid, because of the expense of putting in proper apparatus and not seeing the advantage of it at all.

Q. 16. What pressure did you use when you used the lime in the digester?

A. About 140 pounds at that time—that is, when we commenced with lime.

Q. 17. What did you use subsequently; have you ever used any different?

A. A long time after that, though I can't recollect when, the pressure was lowered down to 90 pounds with two per cent. of lime, and, as I told you, it is a long time ago, but now within the last three months I made another experiment here at Mr. Dreyfus', in Jersey City, with 90 pounds pressure and two per cent. of lime and about six to seven hours work, the pressure which produces a very nice goods, but in that apparatus we used superheated steam.

1569 Q. 18. How long did you continue to use the 140 pounds pressure and two per cent. of lime?

A. We used that in our establishment in Cologne for six or seven years after, about that time, about six or seven years.

Q. 19. What were they using when your connection with the company terminated in 1870?

A. In Cologne we were using that still; but in our establishment in Brussels we did not put in apparatus for high pressure. In Brussels we used open tubs with acid. Of course, we took a great many informations about digesters at that time, to try to see which was a good one to be used cheaper than our open tub. We sought information about a great many processes—the Tilghman process, Wright & Fouché, Melsen's, and Hulterhoff, of Buenos Ayres. Hulterhoff came to my house at that time to induce me to take the Tilghman process—he had worked it in Buenos Ayres—but we did not see any advantage; the goods that he showed us at that time I recollect they were not nice at all, so we would not take the process; he showed us some samples at that time of the candles and fat acid, but I didn't like it at all, so I gave up the process altogether, and afterward I heard Mr. Hulterhoff had failed himself in Buenos Ayres; that is a known fact that he failed in Buenos Ayres; he could not make any good success, then, in Buenos Ayres; it was the best place *at* all; they had no lime and no acid or anything of that kind, and we used to send a great deal of candles to Buenos Ayres; we did at that time; so we thought he could beat us by his apparatus in Buenos Ayres, being in a position to make them cheaper, and we thought Mr. Hulterhoff would prevent our selling candles in Buenos Ayres, but he failed—that is to say, became bankrupt.

Q. 20. Was it before or after you made your experiment with water alone in the digester that Hulterhoff proposed to you to adopt the Tilghman process?

1570 A. It was after.

Q. 21. What was the process described to you by Hulterhoff under the name of the Tilghman process?

A. It was using water without lime or anything else at a high pressure—that is to say, 225 pounds pressure—and he described that process [as] being Mr. Tilghman's process—Mr. Hulterhoff did, with heat, of course—225 pounds pressure means a great heat.

By Mr. CHAMBERS:

Q. 22. When you used your digester with twenty-five per cent. of water and a high pressure, did you understand that you were using the Tilghman process?

A. We had the chemist in our establishment who was to study

all those questions, and he saw, of course he studied the process of Tilghman, and process of Wright & Fouché, and he said he could make an apparatus with the spiral giving the same results as Tilghman; that is, saponify the grease with water alone and high pressure without lime, and that was based on the principle of Tilghman and Wright & Fouché, because they are based on that principle to use water alone for saponifying. It was after that, two or three years after, that Mr. Hulterhoff came to my house in order to propose the process which he called the "Tilghman;" I recollect that very well, that he said, "I use the Tilghman process"—that was what he told me; I didn't see the apparatus; saw his samples; they didn't suit me and I didn't want to hear any more about it.

By the MASTER:

Q. 23. Did he describe his process at all or merely say that he used the Tilghman process?

A. Called it the Tilghman process, using digester with
1571 water; that is what he told me at the time, showing at the same time samples obtained from those.

He said, "I am using the water through the Tilghman process," because at that time there was none in Europe used, and I asked him what process he used. He says, "I am using the Tilghman process—that is to say, with water and without lime." I said, "Have you got samples?" He said, "Yes, there they are;" and he showed me some fat acid made out of that process. I told him I can't use that—so that was an end of it.

Q. 23. Did he tell you how the processs was carried on in these digesters?

(Objected to, as the witness has stated "That is all.")

A. No; he told me that was the Tilghman process; that is all. I knew that the Tilghman process was high pressure and forcing circulation without lime.

By the MASTER:

Q. 24. Did he describe to you the apparatus he was using?

A. He simply said he was using a high-pressure digester; that is all; but I did not want more, because I saw it was not good.

Q. 25. (None. Error in numbering.)

Q 26. Did he tell you whether or not he used lime?

A. He told me that he used no lime at all.

By Mr. CHAMBERS:

Q. 27. Did he state to you that he used no lime or did you understand so?

A. No; he stated to me that he used no lime at all, only water.

1572 Q. 28. What opportunities have you had of knowing what process was being used in the candle factories of France and Belgium and other parts of Europe?

A. We were always in communication with all the manufacturers

of candles, as DeMilly, Labchier and Butet, the Goude factory in Holland, Wilson Price in London, Sarg in Vienna, the Neva Candle Works in St. Petersburg, and we were always corresponding together to learn improvements, and especially as to water saponification.

Q. 28. Which of these factories to which you have referred have you been in and seen the process of manufacture carried on?

A. I have seen them all.

Q. 30. About when—during what years?

A. I saw them many times between 1860 and 1870.

Q. 31. So far as you know, how extensively is the process using water under high pressure without lime used?

A. None of them at the time were using it so far as I know.

Q. 32. So far as you know, how extensively has it been used since that time?

(Objected to.)

A. I don't know of any house that uses it in Europe?

Q. 33. Do you know of any that uses it elsewhere at present?

A. No.

Q. 34. When did there begin to be in Europe, or so far as you know elsewhere, a commercial demand for glycerine?

A. That may be about 1864 or 1865, so far as I can recollect, that there began to be a market for it.

1573 Q. 35. You have spoken of the process you recently saw in Dreyfus' factory. Do you know whether that was being carried on as a business?

A. Oh, yes; carried on as a business, manufacturing regularly.

Cross-examination by Mr. CHAMBERS:

X Q. 36. How long have you been in business in New York?

A. About one year, now.

X Q. 37. Engaged in the manufacture of glycerine during that year?

A. The same business; yes.

X Q. 38. Where were you in business prior to going into the glycerine business in New York?

A. Since I left the factory in 1870—sold the Brussels factory to the company—I did not do anything for seven or eight years; took a rest for seven or eight years, about that. Then in 1878 or 1879 I came here and was in some other business, no connection with fat at all, for one year about. Then I went back to Europe; came back here about 1880, about that time; I couldn't tell exactly. Then I went to St. Louis to show a business house there how to bleach grease; from there, about a year after, I went to San Francisco, and there was a candle factory there belonging to Mr. Winter that had given up manufacturing. There was a friend of Mr. Mackay, very intimate with Mr. Mackay, and Mr. Mackay told him that he could use all the candles that he could make there in San Francisco, and even Mr. Mackay put something in that concern to work it up as a stock company. Mr. Mackay said he would take a share in the stock and take all the candles he could make, and I was asked to show how to

make candles; so I went there and there was an old style di-
1574 gester there, working with lime—two or three per cent.—put in little more lime, because tallow was very, very hard there—very difficult to saponify—so I used from 2½ to 3 per cent.; sometimes less, sometimes more; depends on the grease. They worked there for one year—about—but it did not pay; that is to say, tallow was too dear, and the competition of the houses from Chicago was too large—too heavy—so I told them there was no mony to be made at that, and I gave it up and they gave it up too, and after that I went to Europe again, Mr. Mackay telling me, "You go to Paris to study the best means of extracting the glycerine from the water." That was last year. So I went back to Paris and studied the matter very close as to the best means and the cheapest means to extract the glycerine from the grease. So I inquired at that time, one year ago, very much about the water process again, because I heard of it that it had been used by a house in Paris called Besson, and I heard of Mr. Besson having used that process and had given it up, too—could not work it to a profit. I heard so; didn't see it. Then I saw that the process with water no one was working successfully, and then I went to Mr. Baujard, who had a process working with zinc, and we made an agreement with him to use his process here in America, under certain conditions that were determined in the contract. Then I came here with Mr. Baujard, and brought with us two autoclaves or digesters, which we put at work at Mr. Colgate's soap factory.

X Q. 39. Do you buy glycerine from other parties besides extracting it from fats?

A. No.

X Q. 40. After extracting the glycerine, is the remaining substance of the fat used for soap or for candles?

A. For soap so far; but Mr. Baujard pretends that is good for making candles, too.

1575 X Q. 41. Is it a patent process or a secret process?

A. A patent process.

X Q. 42. What process did you use in Brussels immediately before your giving up the business there?

A. Open tub there, with acid, in Brussels, but in the factory in Cologne we were using digester.

X Q. 43. What process were you there using in your digesters at Cologne?

A. With two per cent. of lime, and from 100 to 140 pounds pressure; depends upon the grease—upon the tallow; some require more, some require less.

X Q. 44. In your process, as used in Brussels, with open tubs and sulphuric acid, and subsequent distillation, what products did you obtain? Did you get glycerine?

A. We got glycerine, certainly; 91 per cent. splendid fat acid and five per cent. glycerine, instead of six or seven.

Redirect:

Q. 45. During what years were you in the DeMilly factory, in Paris?

A. From 1858 to 1865—different times—about.

Q. 46. How was the saponification process carried on there?

A. Carried on with lime. Put in digesters with two or three per cent. of lime, according to the different kinds of grease they used; 140 pounds pressure. He told me that sometimes he used 100, and sometimes 125; I can't tell. From 100 to 140; depends.

(Signed) G. JANSSEN.

1576 Meeting at Spring Lake, N. J., Aug. 1st, 1883.

Master and counsel present as before.

EDMOND BAUJARD was called as a witness for the respondents. The witness not understanding the English language, Sylvain Godchaux was produced by the respondents as an interpreter, and, after being duly sworn to faithfully interpret, he proceeded to translate the evidence given.

Direct examination of EDMOND BAUJARD, a witness for the respondents.

By Mr. PARKINSON:

Q. State your name, age, residence, and occupation.

A. My name is Edmond Baujard; my age is 43 years; my residence is at Mamaroneck, Westchester county, New York, and by occupation I am an engineer of chemical products.

Q. 2. Where have [you] resided most of your life?

A. Paris, for studying, education, and afterward at Aubervilliers, near Paris.

Q. 3. In what, if any, occupation were you engaged in Paris, and during what years?

A. In a commission house in chemical products about the year 1861 until 1866 to 1867, and then established myself on my own account at Aubervilliers as stearic acid manufacturer and candles, succeeding Jourdain & Co., until last year.

Q. 4. On what scale were you carrying on the last-named business?

A. Ten thousand kilogrammes of tallow a day.

Q. 5. What, if any, official position did you hold in connection with the trade?

A. Vice-president of the Association of Candle Makers and
1577 Soap Makers of France from the foundation of the society, from about the year 1876 until the time that — discontinued business.

Q. 6. Prior to the foundation of this society had you held any official position in connection with the trade?

A. From 1871 until the foundation of that association I held the position of member of one of the committees which was intrusted to debate all matters pertaining to stearine makers with the government, and before 1871 I was secretary of the Free Association of Candle Makers.

Q. 7. What is the purpose or what are the functions of this organization of which you say you were vice-president?

A. To uphold the interests of the candle makers with the government on the question of transportation, and to adjust all the differences between the candle makers.

Q. 8. What, if anything, had this organization to do with the fixing of grades of the product of candle makers?

(Objected to as leading. Objection overruled. Complainant excepts.)

A. To establish the melting point in order to determine the value and analyze it if necessary.

Q. 9. During the years you were manufacturing candles in Paris to what extent did you know what processes were being used in other factories in Paris, and in other parts of France, for saponification of fats for candles?

A. In Paris I visited all the factories, and in the interior I visited several of them.

Q. 10. State whether or not you saw the process of saponification for candles used in the factories you have referred to as having visited, and also state what processes were used.

1578 A. I have seen the process of saponification by water at Besson's, and the process of saponification by lime at the others.

Q. 11. Do you know whether the process by water is still used in the Besson factory?

A. No; it is not used any more.

Q. 12. When was it given up?

A. The factory is out of existence a year and a half since, at which time Mr. Besson sold his factory to a company; the company closed the factory. He had abandoned that process three or four years before he sold out, I think. I do not know exactly the date. I know absolutely it was abandoned.

Q. 13. Can you state with what degree of pressure this process was carried on in Besson's factory?

A. 16 atmospheres is as much as I can remember. That is equivalent to 225 pounds.

Q. 14. In what kind of an apparatus was it carried on, and with about what per cent. of water?

A. A long horizontal autoclave or digester of copper. He used water to half the volume of fat or tallow; not absolutely certain about this.

Q. 15. State how it was heated.

A. Mr. Besson used a Bellville boiler that communicated with the digester by a close coil tube; the return of steam was effected in the boiler again.

Q. 16. In how many factories in Paris did you see what you have spoken of as saponification by lime carried on?

A. In six.

Q. 17. Describe that process.

A. They treat the neutral fatty matters in a digester, combined with two per cent. of lime diluted with water. The proportion of water varies with different manufacturers; generally one-third.

They submit this mixture to steam at from eight to nine atmospheres pressure during 3½ hours to 4 hours. You then ob-
1579 tain calcareous soap, which is decomposed by sulphuric acid. The glycerine finds itself separated, and the fatty acids are submitted to the action of cold and hot presses.

Q. 18. How many factories were there in Paris when you were in this business in which saponification for candles was carried on?

A. Six by saponification and five by distillation.

Q. 19. State whether or not you have ever seen in Paris or elsewhere in France the process of saponification by water alone carried on in any establishment other than that of Besson.

A. I have not seen any, but knew of two manufacturers that used the same process.

Q. 20. When did you know of these two other manufacturers using the same process, and where were they?

A. In 1868 or 1869. One was Perry & Son, of Elbeuf, and the other was Lenoir, of Mecon.

Q. 21. Do you know how late these two manufacturers continued to use that process?

A. Until about 1872 to 1873. Mr. Perry must have ceased using that process in 1871 or 1872.

Q. 22. Do you know what they have used since?

A. Saponification by lime, same as I have described.

Q. 23. Did you ever see and examine the stearic acid or candles made by the water process in either of the factories referred to; and, if so, how did they compare with those made in the factories using what you have described as the lime process?

A. The product of the process of the saponification by water was inferior in quality, as well as the price, as compared with grades of the other factories.

Q. 24. Do you know how they were graded by the association?

A. The product of the saponification by lime was first in order, and the product of saponification by water ranked afterward.
1580 The association did not concern itself by what process the product was made; but I desire to state that I know by private information that the products of Mr. Besson were the lowest quoted in Paris.

Q. 25. Did you ever observe what was the quality of the red oil obtained from the water process?

A. It was, in appearance, black, and contained fatty neutral matter on account of incomplete saponification, which made the liquid appear not clear.

Q. 26. What process did you use in your factory?

A. The lime process, same as already described.

Cross-examination by Mr. CHAMBERS:

X Q. 27. What business are you now in?

A. I am attached to an enterprise having for its object the extraction of glycerine from fatty neutral matter used in soap manufactures.

X Q. 28. Why did you give up your business of manufacturing soap and candles in France?

A. Because I sold out.

X Q. 29. How did your candles compare in quality with those manufactured by other French manufacturers while you were in business?

A. They were classed in the best quality.

X Q. 30. How many different classes were there?

A. Four.

X Q. 31. Were Besson's candles inferior to yours?

A. Yes.

X Q. 32. Noticeably so?

A. Noticeably so.

X Q. 33. Your candles then, I infer, sold at higher prices than Besson's?

A. Yes.

X Q. 34. In which of the four grades were Besson's candles classed?

A. My answer to question 29 was misunderstood. I meant
1581 that every candle manufacturer in Paris produced four grades of candles. Mr. Besson was classified inferior to any others for stearic acid.

X Q. 35. Did he sell stearic acid unmanufactured into candles—that is, not made into candles?

A. Yes. That was the reason of my observation before, because Mr. Besson sold stearic acid in blocks. He did not manufacture candles himself.

X Q. 36. The candles, then, which were made from Besson's cakes by others are the candles you referred to as being inferior to your own manufacture?

A. Yes. The quality of the candles is judged at by the quality of the stearic acid.

X Q. 37. Did you ever examine the apparatus used by Besson?

A. Yes.

X Q. 38. Inside as well as outside?

A. I did not go in.

X Q. 39. You do not know, then, whether he had any arrangement for causing a mixture of the fat and water in the autoclave or digester?

A. I know he did not have any, because Mr. Besson told it to me.

X Q. 40. You do not know, I suppose, whether the other two manufacturers who you heard were using this process had any mixing device or not?

A. When Mr. Perry changed his process of manufacturing he came to see me, and explained to me what his process was, and it was similar to that of Mr. Besson. Lenoir employed the same as Besson. The three of them were erected by a Mr. Renner, a manufacturer who had tried to establish that process of saponification by water and had not succeeded.

(Signed) E. BAUJARD.

(It is agreed that the extract from Payen, cited in question 64 of Henry Morton's deposition, is found in identical terms in the
1582 edition of the same author of 1861; also that the extracts offered as exhibits in connection with the deposition of either party hereto shall be received as *prima facie* evidence under the terms of the stipulation on pages 144 and 145 of the master's record.

Defendants here offered in evidence certified copy of English letters patent to Wilson & Payne for "improvement in treating glycerine," dated February 8th, 1855, and same was marked "Defendants' Exhibit Wilson & Payne Patent of 1855.")

The defendants here rested their case.

Adjournment was then had to August 3rd, 1883, at 10 a. m., at Philadelphia, Pa.

1583 *Complainant's Testimony in Rebuttal.*

United States Circuit Court, Southern District of Ohio. In Equity.

R. A. TILGHMAN, Complainant,
vs.
PROCTOR & GAMBLE *et al.*, Respondents.

Accounting before Channing Richards, Esq., master.

AUGUST 3D, 1883.

Meeting at 901 Walnut street, Philadelphia, Pa.

Master and counsel present as before.

Complainant's counsel, under the stipulation made May 21, 1883, and printed in the master's record at the end of the deposition of H. Endemann, on pages 144 and 145, offers in evidence further extracts from Wagner's Year Book for 1863, said extracts forming the immediate context of "Defendants' Exhibit No. 2," the portion of the translation now offered which forms said "Exhibit No. 2" being underscored. The same is marked by the master "Extract from Wagner's Year Book. Context of Defendants' Exhibit No. 2."

1584 Counsel for complainant offers in evidence extract from Reports of Juries, London Exhibition of 1851, printed in London, 1852, page 607. The same is marked "Complainant's Exhibit No. 10. Reports of Juries."

Also extract from Morfit on Soap and Candles, published in Philadelphia in 1848, pages 195 and 434. The same is marked "Complainant's Exhibit No. 11, page 195. Morfit on Soap and Candles."

Also extract from Ure's Dictionary of Arts, published in Boston, 1853, vol. II, page 673. Offered in evidence as "Complainant's Exhibit No. 12. Ure's Dictionary."

Also extract from Roret's Encyclopædia, published in Paris, 1849, and forming the immediate context preceding the Exhibit "Roret," printed on page 474 of the Supreme Court record. The same is offered in evidence as "Complainant's Exhibit No 13. Roret's Encyclopædia, page 474."

Also extract from Musprat's Chemistry, vol. II, page 879. The

same is marked "Complainant's Exhibit No. 14. Musprat's Chemistry, 2–879."

Also extract from Roret's Encyclopædia, published in Paris in 1849, pages 109 and 114. Offered in evidence as "Complainant's Exhibit No. 15. Roret's Encyclopædia, pages 109 and 114."

Also extract from Musprat's Chemistry, vol. I, page 430. Offered in evidence as "Complainant's Exhibit No. 16. Musprat's Chemistry, 1–430."

1585 Also extract from Morfit on Soap and Candles, published in Philadelphia, 1847. Offered in evidence as "Complainant's Exhibit No. 17. Morfit on Soap and Candles, page 430."

Also extract from Pelouze & Fremy's Chemistry, published in Paris in 1865, vol. V, page 948. Offered in evidence as "Complainant's Exhibit No. 18, Pelouze & Fremy, vol. v, 948."

Also extract from Mohr, Redwood & Procter's Pharmacy, published in Philadelphia in 1849, page 488. Offered in evidence as "Complainant's Exhibit No. 19. Mohr, Redwood & Procter's Pharmacy, page 488."

Also extract from Pelouze & Fremy's Chemistry, published in Paris in 1865, vol. V, page 951. Offered in evidence as "Complainant's Exhibit No. 20. Pelouze & Fremy's Chemistry, vol. V, page 951."

HENRY BOWER was then called as witness for the complainant, and being duly sworn testified as follows:

Examined by Mr. CHAMBERS:

Q. 1. What is your name, age, residence and occupation?

A. My name is Henry Bower; fifty years of age; residence, Philadelphia; occupation, manufacturing chemist and refiner of glycerine.

Q. 2. Are you the same Henry Bower who testified as a witness in the case of Tilghman *vs.* Mitchell, and whose testimony is printed in the Supreme Court record in this suit, commencing on pages 229 and 947?

A. Yes, sir; I am the same man. I recognize the testimony.

1586 Q. 3. State if you have purchased crude glycerine from Roland G. Mitchell, of New York; and, if so, about when you commenced to purchase such glycerine, and how long you continued to make purchases from him.

A. I commenced to purchase glycerine from Mitchell before he used the water process. I should suppose it was about 1862 when I commenced purchasing. I think it was about that time, or within two or three years of that date, that he commenced the water process. I purchased some before that, made by the old-fashioned lime saponification.

Q. 4. And you continued to purchase from him for how long?

A. I may say until the present.

Q. 5. After Mr. Mitchell adopted what you speak of as the water process, was there any difference between his glycerine and that of other manufacturers?

(Objected to as not competent in rebuttal.)

A. I can't answer that question exactly. I will answer it in my own way. Mitchell's glycerine has always been—up to within a few years past; I can't say exactly how many years—the best crude glycerine that I know of in this market; but there are possibly some other manufacturers with whose productions I am not sufficiently acquainted to say exactly what the quality now is. It occurs to me that I have seen some samples of glycerine within the last two or three or four years made by other manufacturers that might be considered quite as good as that Mitchell makes.

Q. 6. I understand you that at the time, and for some time after Mr. Mitchell adopted the water process his glycerine was of a better quality than that of the other manufacturers?

(Same objection and as leading.)

1587 A. At the time; oh, yes.

Q. 7. To what was this superiority due?

(Same objection, and as otherwise incompetent.)

A. Well, chiefly due to the absence of lime.

Q. 8. Is this same feature of absence of lime in Mitchell's glycerine continued up to the date of your last purchases from him?

(Same objection.)

A. It is.

Q. 9. Have you purchased glycerine from Mitchell within the last year?

(Same objection.)

A. I have.

Counsel for defendants object to the foregoing deposition as incompetent in rebuttal, and proceeds then to cross-examine the witness.

Cross-examination by Mr. PARKINSON:

X Q. 19. How many grades of crude glycerine are there offered in the market?

A. The grades of glycerine commercially are what are called saponified, which means the water process article; the distillation glycerine, which is made by the sulphuric-acid decomposition process, and what is known as Dutch glycerine, made by the old lime-saponification process. Those are about the three distinctions of commercial crude glycerine.

1588 X Q. 11. Are the glycerines made by different manufacturers by the same process always of equal grade?

A. No; quite various.

X Q. 12. What is your mode of testing crude glycerine to determine its value in purchasing it?

A. Well, the determinations of crude glycerine would be, first, its specific gravity—that is to say, whether it contained more or less water—water, of course, reducing its value; the second would be the amount of inorganic impurities, such as lime, and the third

would be the amount of organic impurities, such as glue or gelatine, etc.

X Q. 13. How are these tests made?

A. The specific gravity is usually tested by taking a sufficient quantity of the glycerine to float an instrument that is called an hydrometer, which marks on a scale the degree of the scale in use, showing the specific gravity; or a quantity is put in a small vessel holding a thousand grains, and from that measurement you calculate the weight or specific gravity. Those are the two modes of determining the specific gravity.

The morganic impurities are detected by taking a weighed quantity of the glycerine and heating to a high heat, when it ignites of its own accord and you allow it to burn off carefully. This residue is weighed at this point after the flame expires, and placed in a platinum capsule, and then burned at a higher temperature. The difference between the two weights of the burnt residue will give you the organic matter, and the final weight the inorganic matter. There is another test which I do not object to give, when testing for organic matter, in order to determine whether or not the glycerine has been distilled, and also in a measure to determine its quality. We take a sample of glycerine and dilute it with one-half distilled water, and shake it up with a small amount of sub-acetate of lead.

All crude glycerine will show a flocculent precipitate, and
1589 distilled glycerine will not show any flocculent precipitate, but only a slight cloud. From the appearance to the eye, one being accustomed to it can determine a good deal of the character of the crude glycerine by this test. The main reason for using this test would be, as I have said before, to distinguish distilled glycerine from undistilled, but it is also a valuable guide in detecting whether glycerine has been made from what is called "good stock" or "poor stock," containing a large amount of gelatine.

X Q. 14. Do you make these tests yourself or have them made for you?

A. Well, that depends upon circumstances. I occasionally make them.

X Q. 15. Usually have them made for you?

A. They are usually made in my laboratory by somebody other than myself.

X Q. 16. Of how many other manufacturers than Mitchell have you during the last three or four years purchased crude glycerine at a price equal to or greater than that paid by Mitchell?

A. Of domestic manufacturers, none. I have bought foreign glycerine that has cost me as much, duty paid and all the expenses.

X Q. 17. Of what foreign manufacturers?

A. I cannot give you the name of the manufacturers. We buy glycerine abroad through commission houses without knowing who are the manufacturers.

X Q. 18. Of what domestic manufacturers beside Mitchell do you buy?

A. I have already stated that I have not bought any glycerine

of those manufacturers who work by the water process within that period (three or four years) other than Mr. Mitchell.

X Q. 19. What other domestic manufacturers have you purchased any crude glycerine — within the last few years?

1590 A. Of glycerine made by what is called the acidification process, from Emory & Sons, of Cincinnati.

X Q. 21. How lately have you bought of Emory & Sons?

A. About a year ago.

X Q. 22. Not any since?

A. No.

X Q. 23. How lately have you bought from any other domestic manufacturer than Emory & Sons and Mitchell?

A. I have not bought any.

X Q. 24. For how many years?

A. Well, I can't say how long since I purchased glycerine from some other domestic makers. I have it offered to me all the time with samples; but I do not think that I have purchased any domestic glycerine except Mitchell's and Emery's, that I have spoken of, within the last four or five years.

(By reason of the witness being obliged to leave town, his further cross-examination was suspended until Monday, August 6th, 1883, at 1 p. m., same place.)

The solicitor for respondents waives further cross-examination of the witness, and also waives the signature of the witness to his above testimony.

Adjourned to August 4th, 1883, 10 a. m.

1591 AUGUST 4TH, 1883.

Meeting at Philadelphia, Pa.

Master and counsel present, as before.

WASHINGTON JONES was sworn on behalf of complainant, and testified as follows:

Examined by Mr. CHAMBERS:

Q. 1. Please state your name, age, residence, and occupation.

A. 1. I am about sixty years of age. My name is Washington Jones. My occupation is that of a mechanical engineer and superintendent of the Port Richmond Iron Works. I reside at 1632 North 15th street, Philadelphia.

Q. 2. Please state how long you have been engaged in the profession of engineering.

A. From my apprenticeship, which dates from about 1840. I have been engaged ever since—draughtsman and superintendent.

Q. 3. Had you occasion, in the course of your business, to acquaint yourself with the proper methods of uniting iron pipes together for different uses?

A. Yes, sir. We make, or did make, an ice machine in which large quantities of iron pipe were used. They were welded into lengths, the required length, taking 250 to 300 feet ordinarily, and

then coiled so as they could be placed in a cylindrical vessel. We have also made the coils in tweers for blast furnaces. We have coiled them, but ordinarily the pipes are long enough. They come long enough to do away with the necessity of welding them in ordinary cases.

Q. 4. Have you read and do you understand that part of letters patent No. 11666 which describes the mechanical construction of a device for treating fats, which is also shown in the drawing forming a part of said patent?

1592 A. Yes, sir; I have read it; I understand it.

Q. 5. Please state how, in your opinion as an engineer, a person skilled in the art of making pipes would unite the lengths of pipe necessary to make such a coil as described in that patent of a length of, say, five hundred feet.

A. I would certainly weld them.

Q. 6. Would there be any difficulty in welding together lengths of pipe sufficient to make a coil of five hundred feet or more, such pipe being one inch external diameter and of ½ inch diameter of bore?

A. No difficulty whatever, sir; can make them any length that could be needed; would even exceed five hundred feet; make them five thousand feet if they want them. We have frequently made them from 250 to 300 feet; thought nothing at all of it; no difficulty about it.

Q. 7. What would you or any skilled engineer or mechanic familiar with the manufacture and use of pipe understand from the description of the patent as to the kind of joint intended to be used in that part of the coil which is enclosed in cast iron?

So much of the question as relates to what others would understand objected to as incompetent.

A. I think that the patent distinctly says that the joining of the pipe is to be done by welding. (Referring to patent.) I will read: "The ends of the tubes are joined together by welding to make the requisite length; but where welding is not practicable I employ the kind of joint used on the Perkins hot-water apparatus, which are now well known."

Q. 8. What part of the apparatus, as illustrated in the drawing attached to the patent, and described in said patent, would require the use of a Perkins joint?

1593 A. Probably that portion of the pipe that is outside of the casting or outside of the furnace where the joints could be got at to screw it up or unscrew it in order to detach the other portion of the machinery

Q. 9. Supposing that description of the patent contained no particular mention or direction as to what kind of joint should be used, but the description as to the coil being enclosed in cast iron, and being exposed in use to a pressure of 2,000 pounds and temperature of melting lead, would there be any doubt or question in your mind, or that of any one familiar with pipe making, as to what kind of joints

should be employed in the portion of the coil which was enclosed in the casting?

A. Well, in building a coil to be used under the conditions you have named I should certainly weld it, for several reasons. The first is, that it would be less expensive; the second is, that in casting the coating upon that coil the natural effect would be to expand the wrought iron, and the expansion would cause a leak, and it might be said that the cont action of the cast iron coating would also cause a contraction of the pipe, but there is no certainty about that—it is very uncertain; and if it did leak there, there is no possible way of making it tight. You cannot get at it to screw it up. Furthermore, if the Perkins joint were put in there the enlarged diameter of that joint would bring it in contact with the adjacent coils, and the effect would be to have no cast iron there to protect it from the heat. I allude now to the coupling of the Perkins joint.

Another objection to the Perkins joint would be that the oil that is necessary to coat the thread would not be entirely cleansed from the metal, and the effect would be that that oil would be converted into gases when the hot iron struck it, and would make air bubbles—cavities—which would further weaken the enveloping cast iron.

Q. 10. Supposing Perkins' joints to be used on the outside
1594 of the coil, or at the two ends of the pipes which extend out from the furnace. If such joints should leak during an operation, would there be any difficulty in stopping such a leak?

A. No, sir; I think not. It would only be necessary to screw them up with the necessary wrench, or pipe-tongs as they call them.

Q. 11. Please examine the drawing called a longitudinal section of Perkins' joint, on the "Defendants' Exhibit Procter & Gamble Coil No. 1," and state whether such drawing illustrates a Perkins joint made in a proper and workmanlike manner.

A. That is not made as I would make a Perkins joint, for the reason that we find on the right-hand side of the pipe marked right—that I presume alludes to the thread, the angle in which the thread is put upon the pipe—and on the left-hand side it is marked left, and at the junction of the two threads, where the threads should be cut out in order to let the two that form it pass into an open space and form no thread, that is not here. Now, these two threads run together, and their junction forms the apex of a triangle. Now, if the right-hand thread be screwed too far into coupling it runs into the left-hand thread, or makes the effort to do so—of course it could not do it—and unless this coupling is put on with extreme nicety, so that the thread on the pipes and the thread on the coupling shall coincide, it will be impossible to make the joint, and the construction is such that the screwing up there will not permit of the Perkins joint to be made, because one essential is that the metal shall be crushed or mashed, as it were, one into the other.

Q. 12. Supposing such a coil as I have described to you in my questions was made with welded joints instead of Perkins joints, would there, in your opinion, be any tendency or great liability of the casting which surrounds the coil pipes to split or crack?

A. Well, a person not acquainted with the art of putting
1595 cast iron upon a coil might fail in that, but we have no difficulty whatever in casting what we call "tweers" for blast furnaces, which consists of a coil pipe with a coating of cast iron upon it. That is not an every-day occurrence, but a very frequent occurrence in all the blast furnaces of the country.

Q. 13. Please make a drawing or sketch of a Perkins joint made in the way that a skilled engineer would make such a joint?

A. I have done so.

Plaintiff's counsel offers said sketch in evidence as "Complainant's Exhibit No. 21, Perkins joint."

Q. 14. Would there be any difficulty in attaching two or more pumps to the supply tube of such an apparatus as that shown in the drawing of Mr. Tilghman's patent, so that any one of them could be used and the others thrown out and brought into use successively if desired?

A. There would be no difficulty whatever; one pump could be shut off by means of a valve or cock whilst the other was in operation, and *vice versa*.

Q. 15. Have you in the course of your professional experience had occasion to design or observe the use of pumps for hydraulic machinery, hydraulic lifting jacks, etc.?

A. Yes, sir; we have built a good many hydraulic presses, pumps, and caloric engines, all using cup-leather packing.

Q. 16. What pressure is used in such hydraulic machinery as you have mentioned?

A. From four to five tons to the inch in hydrostatic machinery.

Q. 17. Do you know whether it has at any time been customary or usual to use vegetable or animal oils in hydraulic jacks or lifting devices?

A. They use animal oil, fish oil, whale oil, or use mineral oil; any fluid that will not become viscid by use or having too much body will answer very well.

1596 Q. 18. Where animal oil is used in such jacks is any difficulty found with the cup leather?

A. Not that I am aware of.

Q. 19. Are such jacks or lifters habitually used out-of-doors as well as indoors?

A. Yes, sir; we have six or eight in almost constant use at our works; use them in all weathers.

Q. 20. When such jacks using animal oil have been exposed to the summer sun, do you find that the cup leathers would give out within very short times?

A. I presume your question means whether it gives out from the effect of the oil upon the leather or of the temperature. We find they give out more from hard work than anything else, being strained beyond their capacity. We have never attributed their failure to the use of any particular kind of fluid, oil, alcohol, whiskey, and water—any fluid; one is just as good as another.

Q. 21. How long do such leather packings last usually when used with jacks?

A. Well, I do not know that I could answer that question. The giving out is of such an infrequent occurrence that we make no note of it.

Q. 22. Have you in the course of the practice of your profession familiarized yourself with facts necessary to enable you to fix the amount of power required to run a pump under any given circumstances?

A. Yes, sir.

Q. 23. Have you or your firm made any digesters for Mr. R. A. Tilghman with pumping apparatus?

A. Yes, sir.

Q. 24. Please look at the drawing, defendants' exhibit, drawing taken from appellants' brief in the Supreme Court, and state whether that substantially represents the digester which you made for Mr. Tilghman?

1597 A. I find substantially the digester—the copper chamber inside, the pump and the machinery for giving it motion, the pipe to convey the water to the top of the screen, or, as it is called, perforated diaphragm.

Q. 25. Please state what power would be required to actuate a pump in such a digester as that illustrated in the drawing under the following conditions: the water in the digester being eight feet deep and the oil above it sixteen feet, the pump being about eighteen inches in diameter and the stroke of the pump being sixteen inches and a half, and the number of strokes per minute being fourteen.

It is admitted by counsel for the defendants that the dimensions and conditions given in the question are slightly in excess of those used by the defendants.

A. It is almost inappreciable. It is about a tenth of a horse power or less. I doubled the actual horse power to allow for the friction, which there will be more or less; nobody can calculate what that is.

Q. 26. When in full work how many men do you employ?

A. We have between four and five hundred men.

Cross-examination by Mr. PARKINSON:

Q. 28. About how many digesters for treating fat have you, or the company with which you are connected, constructed for Mr. Tilghman? I refer to digesters on a working scale.

A. Mr. Tilghman commenced the manufacture of those digesters during my absence from the establishment during the war. After I returned I know of two; one, I think, went to Cincinnati; I forget for whom; the other went to Jersey City for Mr. Grosse. That was under my own immediate charge, the latter one.

X Q. 28. Has that company, so far as you know, ever constructed for Mr. Tilghman digesters different in character from that represented in the drawing from appellant's brief above referred to?

1598 A. No, sir; not that I am aware of, no substantial difference. The main features are the same. The drawings for

these digesters come under my notice occasionally, and I presume that the digesters were built to the drawings.

X Q. 29. Supposing a coil of pipe, say five hundred feet in length, after being coiled, placed in a body of iron cast about it, having joints within that body of cast iron formed in the way you understand to be represented by the drawing, "Defendants' Exhibit Proctor & Gamble, Tilghman Coil No. 1," and water driven through that coil heated in it to about the melting point of lead and water, a pressure of about two thousand pounds, would or would not those joints leak?

A. I think that the possibilities are that expansion would take place in this large body of metal there, and that the two ends of the pipe would be drawn asunder and a leak would take place at that point. I do not say it would do it, but I say that the probabilities or possibilities are that it might.

X Q. 30. Which would you say, possibility or probability?

A. I would say possibility, because there is no certainty about it. If you will permit me I will amend my answer. If it is made according to that drawing I will say that it is almost certain to leak. I was thinking of the Perkins joint as I make it, as they are ordinarily made, although your question referred particularly to that drawing.

Signature of witness to deposition waived.

Complainant's counsel offers in evidence the drawing of the defendants' still prepared by Mr. Gamble, as stated in his testimony, said drawing being marked "Complainant's Exhibit No. 22,
1599 Drawing of Defendants' Still." Also sheet of drawings referred to in Professor Booth's testimony, and mentioned in the testimony of the defendants' witness, Morton, said sheet being marked "Complainant's Exhibit No. 23, Drawings of Digester Apparatus." Also table of the specific gravities of glycerine solutions, which is marked "Complainant's Exhibit No. 24, Specific Gravity of Glycerine Solutions." It is agreed that this table shall be accepted as correct, unless notice to the contrary is given before the hearing before the master, and in case such notice is given complainant shall have an opportunity of supplying a duly authenticated table.

1600 Circuit Court of the United States, Southern District of Ohio.
In Equity.

RICHARD A. TILGHMAN, Complainant,
vs.
WILLIAM PROCTOR *et al.*, Respondents.

The following deposition was taken on behalf of complainant on Thursday, May 24th, 1883, by consent, to be used as though taken after respondents have completed their testimony.

Present: The master, also F. T. Chambers, Esq., solicitor for complain-t, and R. H. Parkinson, Esq., solicitor for respondents.

JOHN J. EMERY, called for complainant, being duly sworn, testified as follows:

Examined by Mr. CHAMBERS:

Q. 1. What is your name, age, residence, and occupation?

A. My name is John J. Emery; age, 46; occupation, manufacturer of candles; residence, Cincinnati.

Q. 2. How long have you been engaged in the business of manufacturing candles?

A. About thirty years.

1601 Q. 3. From what material do you make your candles?

A. Principally of low grade grease.

Q. 4. How do you treat the grease before converting it into candles?

A. We treat the grease with six per cent. of acid, sulphuric acid, and distill afterward. The result is fat acid, from which the candles are made in the usual manner.

Q. 5. Have you always used this process of converting grease into fatty acids?

A. No; not always. We used the old lime-saponification — previous. We have used the sulphuric-acid distillation process for 26 years.

Q. 6. Have you heard of a proposed process for decomposing neutral fats into fatty acids and glycerine by distillation in a current of steam without acidification?

A. I have heard of it, and have tried it.

Q. 7. Please state the results of your trial.

A. The result was that there was so much acrolein- produced as to drive all the workmen out of the place, and the result on the product itself was not what we desired—did not produce the good product.

Q. 8. Is this process used in any manufactory in the United States, as far as you know?

A. It is not.

Q. 9. Do you think it possible to profitably manufacture fatty acids and glycerine from neutral fats by steam distillation alone?

(Objected to as incompetent, because the witness has not shown such special scientific or practical knowledge of the particular art referred to, or such experience with the process mentioned as to qualify him for the expression of an expert opinion.)

A. I think it is impossible.

Q. 10. Would your opinion be modified or qualified in any
1602 degree by the fact that two respectable chemists had succeeded in a laboratory experiment and dealing with a quantity of fat amounting to about a third of a pound in distilling over less than half of the quantity of the fat treated, producing fatty acids and glycerine and without producing any smell of acrolein-. In answering this qnestion please look at the drawing "Def'ts' Exhibit

Distilling Apparatus," which was the apparatus used in making such experiment.

(Objected to as incompetent.)

A. I should prefer to trust to practical tests with a quantity which could be used on a paying basis in a factory. With a small apparatus like this, with such a minute quantity of fat in it, the smell of acrolein would not drive the workmen from the place—the chemists from the premises, but as a practical working apparatus on a scale that would pay it is impossible for the workmen to stay about the place; it blinds them.

I said I preferred — to trust to practical experiments than to any theoretical experiments by chemists. I have often found a theoretical experiment by chemists to not work practically.

Q. 11. What percentage of sulphuric acid do you use in acidifying the fat before distillation?

A. Six per cent.

Q. 12. Is this the only process for decomposing fat you employ at your factory?

A. We have what we call the tank process. I think it is sometimes called the Tilghman process.

Q. 13. What do you do with the product of the tank after the fats have been decomposed in it?

A. In low-grade fats we distill it over again to give it a good color—distill it afterwards to give it a good color. In the higher grade stock we do not distill; it is ready for use.

Q. 14. Then, in treating high-grade fats, you use the Tilghman process alone, and with low-grade fats you use either sulphuric-acid distillation alone or the Tilghman process followed by distillation?

1603 (Objected to as incompetent, especially as assuming that the process referred to is the Tilghman process, and it not appearing that the witness has so characterized it, or has any familiarity with the Tilghman patent.)

A. Yes, sir.

Q. 15. Which process do you consider the best and most profitable, sulphuric-acid distillation or treatment by the Tilghman process followed by distillation of the fatty acids produced? I refer, of course, to the treatment of that class of fats which, by reason of their impurities, are not fit for use by treatment with the tank process alone.

(Same objection.)

A. I consider the Tilghman process followed by distillation far better than the acidification followed by distillation; the one saves the glycerine and the other does not, or saves such a very small quantity of it, or of such inferior quality that it is hardly worth while to save it.

Q. 16. Please describe the apparatus and process used by you in carrying out what you call the Tilghman process.

A. It is a tank—a very strong tank—has a pressure of, I think, 180 pounds to the square inch. It is agitated by water, a pump kept going for several hours. We put in water and grease and one per cent of lime.

Q. 17. In the experiments which you state you made with the steam-distillation process of neutral fats, did you find that undecomposed neutral fat would distill over into the condenser or not?

A. Oh, yes; it will distill.

Q. 18. Was the product which you obtained by this distillation fit for use—that is, will it press properly and make a good quality of candle?

A. It is slippery stuff; wouldn't press; the oil would not separate from the stearine.

1604 Cross-examination by Mr. PARKINSON:

X Q. 19. What part of your business do you give special attention to?

A. All of it.

X Q. 20. Indiscriminately? Do you purchase the materials personally?

A. Yes, sir.

X Q. 21. Most or all of them?

A. I see everything that comes in; sample everything that comes in. There is a large part of it bought by agents at distant points.

X Q. 22. Do you make the purchases—a large proportion of them—personally?

A. I do.

X Q. 23. What proportion?

A. Well, I can't say what proportion. There is a good deal of the time I am out of the city, and my brother attends to the business when I am away; but generally one or the other is out of the city, and the one that is here manages the whole affair, superintends the whole thing.

X Q. 24. Are you out of the city half the time, the greatest part of the year?

A. Well, I suppose forty per cent. of the time I am out of the city.

X Q. 25. When you are in the city you are engaged in other business also, are you?

A. Oh, yes; got other business besides this.

X Q. 26. You are doing a large real estate business, are you not?

A. Yes, sir; more so the last few years than twenty years back.

X Q. 28. One of the largest, if not the largest, done in this city?

A. Well, I don't know about that; I don't know how much real estate other people own or how much I own. I have enough trouble to watch it, too.

X Q. 28. You also attend personally to the selling of goods generally?

1605 A. I fix prices.

X Q. 29. What further in connection with the selling of goods do you have to do?

A. Manage the finances and look over the factory.

X Q. 30. Have you a superintendent in your factory?

A. There is no foreman over the whole affair. There is a foreman over each department.

X Q. 31. How much of your time do you spend in your factory, in the part of the factory where the process of decomposing fats is carried on?

A. Now? We have stopped now. We are not doing anything now; it is summer time. Do you mean the average for the past 26 years in which I said I had been in business?

X Q. 32. How much have you — during the last ten years? You understand my question refers to your personal presence in that part of the factory where the decomposition of the fats is carried on.

A. I could not state exactly the average time I have spent there, but I am out there half a dozen times a day—it is close to the office, and I am in the office ready to be called any time they want me.

X Q. 33. That means such days as you are at the office?

A. Yes, sir; exactly.

X Q. 34. How much time do you spend in that part of the factory when there?

WITNESS: Each time I go there?

COUNSEL: Yes.

A. Oh, I suppose a quarter to half an hour.

X Q. 35. Then you would spend, on — average, from two to three hours a day in the part of the factory where the decomposition of the fat is carried on, would you?

A. Yes; in the neighborhood; very close to the press-room.

1606 X Q. 36. I refer not to the neighborhood, but to the immediate place?

A. Yes, sir.

X Q. 37. How much of your time, if any, do you spend in the part of the factory where the candles are made?

A. Well, I don't spend more than half an hour a day there; we have an excellent superintendent there. He manages that uncommonly well.

X Q. 38. What kind of a superintendent or foreman have you in the department where the decomposition takes place?

A. Well, not so good; and that is the reason I am out there oftener.

X Q. 39. Your works are run night and day?

A. Yes.

X Q. 40. What other work is carried on at that factory beside making candles?

A. Nothing else.

X Q. 41. You are the proprietor of several hotels here, and engaged in several other branches of business besides those named, are you not?

A. The hotels are run by stock companies. I have an interest in the buildings. I have nothing to do with the management of the

hotels. I do not know of any other business I am engaged in except the candle business and looking after my property.

X Q. 42. Did you yourself ever work regularly in the part of your factory in which the decomposition of fats is carried on, and in connection with the process of decomposing it? If so, when and to what extent?

A. If you mean worked at manual labor, I never did; but for the past 26 years I have been, as I said before, when in the city, in the decomposing room half a dozen times a day, watching the operation and superintending the men.

X Q. 43. Referring now to this distillation process which you say you have tried and abondoned, when did you make that trial?

1607 A. What distillation process do you speak of that we have abandoned? I didn't say that we had abandoned any distillation process.

X Q. 44. Have you tried a distillation process, using steam superheated, for the decomposing — your fats?

WITNESS: You mean on neutral fats?

COUNSEL: Yes.

A. We tried that twenty years ago—twenty-five years ago—and found it was impossible to do it. We never worked it any more. We were satisfied it was an impossibility.

X Q. 45. Was it twenty or twenty-five years ago?

A. Well, it was twenty-five years ago.

X Q. 46. Are you sure it was not thirty?

A. Yes, I am quite sure.

X Q. 47. Was it between twenty-five and thirty?

A. I know it was twenty-five years ago.

X Q. 48. Do you mean that it was exactly twenty-five years ago?

A. Yes, sir; that is just what I mean.

X Q. 49. How do you fix the date?

A. We started distillation in 1857—that was twenty-six years ago; and I know it was the end of the season—the first season—that we tried this process of working it without any acid.

X Q. 50. Where was that trial made?

A. In our factory, in the still-room.

X Q. 51. Who made it?

A. The workmen employed about there; I don't know their names.

X Q. 52. What was your position in the factory at that time?

A. Well, I was one of the proprietors.

X Q. 53. How many experiments did you make, and during what length of time?

A. Well, I think we got through experimenting with that thing in about two or three days.

1608 X Q. 54. Can you name anybody who was present besides the employees ordinarily about the factory?

A. No; I cannot.

X Q. 55. What kind of apparatus did you have to make the experiments with?

A. The same kind of apparatus; made on the same kind of apparatus that we made the sulphuric-acid process in.

X Q. 56. Describe it as it was used at that time.

A. Well, it was a copper still holding about six thousand pounds, with copper condensing pipes, and the acrolein- so affected the men's eyes that it drove them out of the place. The eyes got all red. It was a very large room, too—40 feet high.

X Q. 57. What was the temperature of the steam?

A. Well, I don't know; it was superheated steam run through a red-hot pipe for perhaps one hundred and fifty feet, red-hot cast-iron pipes; enough to dry the temperature.

X Q. 58. Could you tell approximately what the temperature was?

A. No; I do not think I could.

X Q. 59. What was there in the still besides the fat and the steam?

A. There was not anything except the thermometer.

X Q. 60. Was there a thermometer in the still?

A. Yes.

X Q. 61. You did not notice the registration of the thermometer?

A. No; I do not know. It varies according as you shovel in coal. If you threw a few shovels of coal beneath the still it would send up the temperature fifty degrees.

X Q. 62. But you could not tell what the registration was at any time during the experiment?

A. No; I do not remember about the thermometer.

1609 X Q. 63. What were the dimensions of the still, and what the dimensions of the inlet and exit pipes by which the steam was introduced and carried off?

A. I think it was about a two-inch pipe leading into the still; it was a steam-pipe.

X Q. 64. How large leading away from the still to carry off the steam?

WITNESS: Carry off the vaporized grease?

COUNSEL: Carry off whatever was passed out as vapor.

A. The steam-pipe going into the still was two inches in diameter, and the outlet to the still began at, say, eighteen inches, and tapered off into six inches by the time it reached the condensers.

X Q. 65. Was there any fire directly under the still?

A. Yes.

X Q. 66. The still was heated, then, as well as the steam which entered it?

A. Yes, sir.

X Q. 67. What amount of fat did you use?

A. We used grease.

X Q. 68. What kind?

A. Hog grease mixed with tallow grease.

X Q. 69. Did you test that fat to ascertain particularly its grade; and, if so, can you state about it?

A. I do not remember exactly. You see that was twenty-five years ago. I know it was what we call brown grease. I cannot re-

member the exact color of it. I know it was darker than could be used now by the tank process.

X Q. 70. Did you analyze the product coming from the still?

A. No; I did not.

X Q. 71. Was it analyzed at all?

A. No; we thought the experiment was not a success, be-
1610 cause the product that came from it was of such a nature as would not press, and it gave off acrolein- besides.

X Q. 72. You do not know at what temperature it began to give acrolein-?

A. Well, if I recollect, it was all the time. It worried the workmen; gave red eyes; no matter what their color was before, it was all red when they got through.

X Q. 73. That one was the only experiment you made?

A. Of that kind. One experiment of that kind satisfied us on that point.

X Q. 74. Did you make any other experiment using only superheated steam in the tank upon neutral fat—in the still?

A. I do not think we ever did. I do not think we could distill without having fire underneath it.

X Q. 75. Did you make any other experiments than the one referred to with fire underneath the still and only superheated steam and neutral fat in the still?

A. That is the very experiment I have been describing. Fire, superheated steam, and neutral fat.

X Q. 76. I asked if you made any other than this one of which you have spoken about.

A. I say no; one was sufficient for us.

X Q. 77. Did you ever put more than one charge of neutral fat in the still for that experiment?

A. We only made one experiment of that kind, so one charge was sufficient.

X Q. 78. Only this one charge?

A. Only used one charge. We thought we punished the men enough on that one charge; we did not want to try it over again.

X Q. 79. What did you do with the product from that experiment?

A. We acidified it and distilled it over again.

X Q. 80. Did you before acidifying put it in the press?

A. No; we could see plain enough it would not press.

1611 X Q. 81. Did you not put it in the press?

A. We may have done so; I don't remember. You can tell very easily by looking at the stuff whether it would press or not. By putting your thumb on it in that way (illustrated) you can tell whether it would press or not; if it won't press it will slip out just like soap, but if it will press you will make a white spot on the stuff and oil will ooze out around your finger.

X Q. 82. Can you say certainly whether or not you put any in the press?

A. I pressed it with my thumb, I know. I know it was a failure.

X Q. 83. That is the only press you are sure you applied?

A. That is the only press I am sure of; but I know the stuff well enough to know whether or not to put it in a press.

X Q. 84. How much product from the tank process, as you use it now do you press with your thumb?

A. I try some of it every day.

X Q. 85. You would not consider that a very efficient means of pressing it for the market?

A. No; I should not.

X Q. 86. When did you begin the process of decomposition by means of a close tank, using hot water under pressure and one per cent. of lime?

A. I did not use it until the first of April of this year.

X Q. 87. How many digesters are you now using for that purpose?

A. We have only one.

X Q. 88. Have you used that constantly since the 1st of April?

A. Yes; until we stopped working altogether, a week or ten days ago.

X Q. 89. When did you purchase that digester?

A. About three years ago.

X Q. 90. How has the larger part of your fat been decomposed since the 1st of April?

1612 A. We ran this tank to its utmost capacity. It was insufficient to work all our grease that we wanted to use, so the balance of it was acidified in the old way.

X Q. 91. What proportion of that which you have decomposed since the 1st of April has been treated in the old way?

A. I suppose one-half.

X Q. 92. Has not considerably more than one-half—

WITNESS: By this tank process?

COUNSEL: Been treated in the old way?

A. No; I think not; about one-half.

X Q. 93. What is the capacity of this tank?

A. I believe it is about seven thousand pounds of fat for each charge.

X Q. 94. Do you mean that the tank digester holds seven thousand pounds?

A. Seven thousand pounds of fat.

X Q. 95. How much water?

A. Well, I don't know exactly how much water they put in.

X Q. 96. Do you know whether there is any steam in that?

A. Yes; there is steam in it.

X Q. 97. What kind of steam?

A. Superheated steam.

X Q. 98. How much water?

A. I don't know how much water.

X Q. 99. Do you find that the superheated steam injures the fat in that digester?

A. It does not.

X Q. 100. What temperature do you keep that digester at?

A. Well, the boiler has a pressure of 180 pounds to the square inch.

The steam, after leaving the boiler, goes through the superheater. I do not know what the temperature is.

1613 X Q. 101. Do you know whether any water is put in there besides what goes in in the form of steam?

A. Yes, there is; but I cannot tell how much.

X Q. 102. Can you give either the amount of pressure or the degree of temperature maintained in the digester?

A. I think that the digester has a pressure of 180 pounds to the square inch. As to the temperature, I do not know what it is.

X Q. 103. Are you sure about that pressure in the digester?

A. Well, about this tank, as I told you, I had only run it since the first of April, and just about that time I met with an accident, and have not watched that tank so closely. I was absent from the factory two weeks. I was not physically able to go out and watch that thing, and there are other things about that I do not know about.

X Q. 104. Was there any steam escaping from the digester?

A. No.

X Q. 105. Are you sure?

A. That is my opinion. I tell you I have not watched that digester. I don't think there is any outlet to it at all.

X Q. 106. What, if any, means of mixing the fat and water and lime is there?

A. Oh! there is a pump inside of it to mix it up thoroughly—the water, the lime, and the grease. The pump keeps going all the time.

X Q. 107. Did you ever use it without any lime?

A. We never did.

X Q. 108. You have been carrying on the business of decomposing fats, manufacturing candles, in the same factory for many years, have you?

A. Yes, sir?

X Q. 109. And on a large scale?

1614 A. Yes, sir; I think so. We have manufactured in that time, I think, by the distillation process, perhaps one hundred and twenty-five to one hundred and fifty millions of pounds.

X Q. 110. Your manufacture of candles is on a large scale—as large or larger than any other in the West?

A. I think so.

X Q. 111. Have you ever used in that digester a larger per cent. of lime than that you have named?

A. We have not.

X Q. 112. Did you yourself ever weigh the charge of fat put into this digester?

A. Yes.

X Q. 113. How many times?

A. The first time—once only.

X Q. 114. Who else was present when you weighed it?

A. Well, one of the workmen was present. We wanted to see how much to put in, and we measured it in a tub. We did not exactly weigh it; we measured it; we measured the number of cubic

feet, and we did ascertain within one or one-half per cent. how much went in.

X Q. 115. How many cubic feet was it?

A. I forget how many cubic feet it was, but I know it was enough to make seven thousand pounds.

X Q. 116. Who did the figuring to reduce it to pounds from cubic feet?

A. I did it.

X Q. 117. Won't you, taking the seven thousands pounds as a basis, figure up the number of cubic feet that would represent?

WITNESS: You want to know how many cubic feet?

COUNSEL: Yes.

A. (Witness makes calculation). About one hundred and twenty-seven cubic feet.

X Q. 118. Was this in a round or square tank when you measured it?

1615 A. It was in a round tank.

X Q. 119. Can you state from the data you have what would be the dimensions of that tank?

A. It was quite a large tank; I suppose it would have held five times that much; four times as much as that.

X Q. 120. Do you know the diameter of the tank?

A. Oh! oh! I think it must have been about twelve feet—say ten feet, and it was filled, perhaps, seven feet deep.

X Q. 121. What proportion of the fat which has been treated in that digester since the 1st of April has been subsequently distilled?

A. Three-fourths of it.

X Q. 122. You have stated that for some grades of grease you found this process, using the digester with high temperature and pressure and lime, more economical than decomposition by the acid and distillation process that you have been using?

A. I should say for all grades of grease it was better.

X Q. 123. Wait till my question is complete, please. Please state what you estimate as to the cost of each process.

A. Well, it is very difficult to state what the exact cost is of each process. It cost a little for steam and for attendance; it is hard to divide up that thing in a big factory. The Tilghman process is the cheaper; there is no acid. When we found how that tank worked we thought we had wasted a large quantity of acid in the past 25 years.

X Q. 124. State, as nearly as you can, the cost of each process—I refer to the cost of decomposition of fat in it.

WITNESS: Do you mean the cost per pound?

COUNSEL: Per pound or per thousand, or any way you please. Give the cost either upon the basis of the product obtained

1616 from the neutral fat that goes in, or both, giving as far as you can the specific items that go to make up the cost in each case.

A. Well, it is a difficult question to answer. I don't know that I

care to answer it, either; but I will say that, in view of the product obtained, the tank process is infinitely superior to the other, because glycerine is saved, and the glycerine is saved in good shape—that is, it is marketable. You get probably four times as much glycerine by the tank process, and it is twice as valuable per pound.

X Q. 125. State just how much glycerine per hundred weight of neutral fat you get when you use the digester with heat and pressure.

A. We have worked the tank so short a time that we have not measured the glycerine accurately. I could not state exactly the per cent. which we get, but the man who works on that department at the glycerine tanks reported that we never had such glycerine before—such rich glycerine and so much of it—as came out of that tank. He called my attention to it, and I went and looked at it and saw what he said was true; but we did not measure it exactly.

(So much of the answer as recites what the witness was told is objected to by defendant's counsel as incompetent.)

X Q. 126. Now, state from your examination just what quantity, or as nearly as you can, what quantity of glycerine per hundred pounds of fat you got from the digester process, and how much from your common process.

A. Well, I have answered you about the digester process that we had not measured that exactly, but for the acidifying process the total result of last year's work—last season's work which we have just finished—was ninety-one hundredths of one per cent. of the fat used by the acidification process.

1617 X Q. 127. Now, state, as nearly as you can, the percentage you got from the other process.

A. I say we did not weigh it, but a rough guess I should say we got five or six times as much.

X Q. 128. That is, you got, you should think, about five per cent.?

A. Five or six times ninety-one one-hundredths.

X Q. 129. That should be a little more or little less than 5 per cent?

A. Five to five and a half per cent.

X Q. 130. By weight?

A. By weight.

X Q. 131. Before or after it had been condensed?

A. After condensation.

X Q. 132. Was the quantity given as obtained by your other process the ninety-one one-hundredths by weight after condensation?

A. Yes, as the result of the whole season's business.

X Q. 133. What treatment did you subject the glycerine obtained by this digester to before disposing of it?

A. Evaporated it, so as to weigh twenty-five degrees.

X Q. 134. What did this glycerine obtained from this digester sell for?

A. It has not been sold.

X Q. 135. What percentage of the neutral fat treated by your common process did you get stearic acid?

A. I don't know as I am obliged to answer that. I rather think that is inquiring of something that is impertinent to the thing. I don't particularly object to answering, but I don't think I ought to. The product depends upon the kind of stock put in. The percentage of stearic acid varies with the degree of pressure we put on it; after it comes along, goes through an hydraulic press; we have had it vary from fifty-six per cent. down to forty and three-fourths per
1618 cent. Fifty-six per cent. was 20 years ago, when the public did not demand such nice candles as they do now. Percentages have been dropping every year—has been down to forty and three-fourths.

X Q. 136. What would be an average yield?

A. That depends upon how hard you press your stock.

X Q. 137. I mean by average; the average as you have got it.

A. If you had pressed it all with hard candles the yield would have been 35; if you press it into quite soft candles it would have been 60.

X Q. 138. Into what grade of candles has the majority of your stock been pressed, soft or hard?

A. Some seasons there has been more soft; the demand varies. The demand at present is for harder candles. Twenty years ago they were satisfied with softer ones.

X Q. 139. What kind of fat have you used in the largest quantities?

A. Low-grade greases.

X Q. 140. How would the yield of stearic acid compare with the higher grades?

A. Much less; considerably less.

X Q. 141. About what range is there in the percentage of the yield from the highest to the lowest grades of fat by any process known to you?

A. Twenty per cent.

X Q. 142. Is not there more than that?

A. Well, I suppose you might get more; nothing that you could buy for that. That is the greatest range; the greatest difference in greases that are for sale for that purpose. You could get some triple-pressed tallow, for instance, and get a still greater difference, but that is never used for that purpose.

X Q. 143. Of whom did you purchase the digester which you use in the process employing heat, pressure, and lime?

A. I don't know.

1619 X Q. 144. Do you know whether it purports to be constructed under any patent?

A. As first constructed it was not a success, and lay idle for about three years, until we got somebody to fit it up this last winter according to all the latest devices of the Tilghman process. It was fitted up by Krieger, Burkhardt & Co.

X Q. 145. Can you state what the difference in construction is since it was fitted up?

A. Well, it has a pump in it now, and did not have one before; that is the principal difference.

X Q. 146. Do you know how circulation was secured in it as originally made?

A. No; I knew it did not circulate; it was a failure, whatever it was.

X Q. 147. When did you first try it?

A. Three years ago.

X Q. 148. Do you know who made it originally?

A. No; I do not.

X Q. 149. Do you know where it was purchased?

A. Here in Cincinnati.

X Q. 150. But you cannot say of whom?

A. No; I could not say without looking at the books; I was out of town when the thing was bought.

X Q. 151. Will you ascertain and state to the master of whom you purchased that digester?

(Objected to as being impertinent to this inquiry or to the direct examination. Objection overruled.)

A. I will get the name and give it when I sign my testimony.

Redirect examination:

X Q. 152. Did you or did you not know at the time you made your experiments to ascertain the practicability of the steam distillation of neutral fats that acrolein would be produced if a high heat was used?

1620 A. I did know it, but I wanted to test it myself; I knew it had been tried before.

X Q. 153. In trying this experiment did you or did you not attempt to keep the heat low enough to avoid the production of acrolein?

A. We distilled as slowly as possible—that is, we kept down the heat.

X Q. 154. How many stills have you at your factory?

A. We have six altogether.

X Q. 155. Would it or would it not be an advantage if you could use these stills to produce fat acids and glycerine without acidification of the fat; I mean, of course, producing a thorough decomposition, say, without producing acrolein?

A. It would be a great advantage.

X Q. 156. And has the practicability of this steam-distillation process of neutral fats been a matter of interest to the trade?

A. It has.

X Q. 157. What is the practical test as to whether material made by decomposing neutral fats is a good commercial product fit for making candles?

A. The color, the smell, and its capability of pressing.

X Q. 158. Will you explain what you mean by the smell being a test?

A. If properly decomposed after distillation it will practically have no odor—a slight odor.

X Q. 159. Is that also true of the treatment by water?

A. Yes, sir.

X Q. 160. Then, if the product has the right odor, or practically no odor, and is capable of pressing properly, it is considered a well-manufactured fat acid, fit for commercial use?

A. It is, provided the color be good.

Q. 161. The color only goes to the appearance of the candle?

1621 A. Some stuff will press white, others will not. It goes to the appearance of the candle.

Recross:

Q. 162. How long have you known of what you term the Tilghman process?

A. Oh! I don't remember. I suppose it is fifteen years or eighteen years.

Q. 163. Did you undertake to carry it on without the use of lime?

A. We never attempted the Tilghman process until last month; never worked it until last month.

WITNESS: Without the use of lime, I think you said?

COUNSEL: Yes.

WITNESS: We never did.

Q. 164. You tried to work it with the one per cent. lime when you first got that digester, two or three *of* years ago?

A. Yes, sir.

JOHN J. EMERY.

1622 *Master's Record on Accounting.*

United States Circuit Court, Southern District of Ohio. In Equity.

TILGHMAN *vs.* PROCTOR & GAMBLE.

Complainant's Exhibits.

"COMPLAINANT'S EXHIBIT NO. 1."

Sulphuric Acid Statement.

Sulphuric acid used in saponification May 1st, 1870, to January 8th, 1875, inclusive.

Date.	Pounds.	Price.	Value.
1870.			
May 10	4,054	3¼c.	$131 75
19	2,013	"	65 42
24	2,072	"	67 34
31	2,043	"	66 39
	10,182		$330 90
June 4	2,036	3¼c.	$66 17
8	2,054	"	66 75
13	2,016	"	65 52
17	2,051	"	66 65
22	2,085	"	67 76
26	2,043	"	66 40
	12,285		$399 25
Aug. 30	2,080	3¼c.	$67 60
	2,080		$67 60
Sept. 2	2,074	3¼c.	$67 40
8	1,473	"	47 87
14	2,055	"	66 78
17	2,077	"	67 50
23	2,059	"	66 91
30	2,014	"	65 45
	11,752		$381 91
1870.			
Oct. 7	2,034	3¼c.	$66 10
12	2,084	"	67 73
17	2,049	"	66 59
20	2,038	"	66 23
25	2,105	"	68 41
28	1,725	"	56 06
	12,035		$391 12
Nov. 2	1,166	3¼c.	$37 89
8	2,065	"	67 11
11	2,053	"	66 72
18	2,052	"	66 69
25	2,081	"	67 63
	9,417		$306 04
Dec. 9	2,030	3¼c.	$65 97
16	2,077	"	67 50
22	2,033	"	66 07
	6,140		$199 54

"*Complainant's Exhibit No.* 1"—Continued.

Date.	Pounds.	Price.	Value.
1871.			
Jan. 6	2,043	3c.	$61 29
12	2,078	"	62 34
18	2,112	"	63 36
21	1,952	"	58 56
27	1,898	"	56 94
	10,083		$302 49
Feb. 3	1,827	3c.	$54 81
9	2,038	"	61 14
14	2,042	"	61 26
17	2,048	"	61 44
22	2,049	"	61 47
	10,004		$300 12
Mar. 2	1,935	3c.	$58 05
6	1,977	"	59 31
10	2,063	"	61 89
15	2,097	"	62 91
18	2,060	"	61 80
23	2,043	"	61 29
28	2,051	"	61 53
	14,226		$426 78
Apr. 3	2,050	3c.	$61 50
7	1,891	"	56 73
12	1,881	"	56 43
18	2,067	"	62 01
24	2,047	"	61 41
28	2,048	"	61 44
	11,984		$359 52
May 4	2,040	3c.	$61 20
10	2,015	"	60 43
17	2,040	"	61 20
22	2,083	2¾c.	57 28
27	2,672	"	73 48
	10,850		$313 61
June 1	2,060	2¾c.	$56 65
7	2,063	"	56 73
13	2,039	"	56 07
20	2,082	"	57 25
27	1,925	"	52 93
	10,169		$279 63
July 3	1,945	2¾c.	$53 48
11	1,979	"	54 42
	3,924		$107 90
1871.			
Aug. 15	2,036	2¾c.	$55 99
21	2,049	"	56 34
26	2,055	"	56 51
	6,140		$168 84
Sept. 1	2,013	2¾c.	$55 35
11	1,747	"	48 04
18	2,035	2¼c.	50 87
27	2,087	"	52 27
	7,882		$206 53
Oct. 4	2,073	2¼c.	$51 82
10	1,803	"	45 07
14	1,814	"	45 35
20	1,876	"	46 90
25	2,011	"	50 27
30	2,053	"	51 32
	11,630		$290 78
Nov. 3	2,064	2¼c.	$51 62
6	1,945	"	48 62
9	2,019	"	50 47
13	1,937	"	48 47
16	1,942	"	48 55
20	1,935	"	48 37
23	2,029	"	50 72
25	2,064	"	51 60
29	1,966	"	49 15
	17,903		$447 57
Dec. 5	2,060	2¼c.	$46 35
9	1,997	"	44 93
13	2,080	"	46 80
18	1,947	"	43 81
22	2,032	"	45 72
28	2,028	"	45 63
	12,144		$273 24

1624 "*Complainant's Exhibit No.* 1"—Continued.

Date.	Pounds.	Price.	Value.
1872.			
Jan. 4	2,005	2¼c.	$45 11
8	2,010	"	45 23
11	2,052	"	46 17
16	1,911	"	43 00
19	1,912	"	43 02
25	2,023	"	45 52
	11,913		$268 05
Feb. 1	2,075	2¼c.	$46 69
8	2,050	"	46 13
14	2,006	"	45 13
17	2,040	"	45 90
19	164	"	3 69
20	1,999	"	44 98
23	2,054	"	46 21
27	2,020	"	45 45
	14,408		$324 18
Mar. 1	2,005	2¼c.	$45 11
6	2,019	"	45 43
8	2,041	"	45 92
13	2,032	"	45 72
20	2,052	"	46 17
23	2,044	"	45 99
27	2,037	"	45 83
	14,230		$327 17
Apr. 1	2,033	2¼c.	$45 74
4	2,032	"	45 72
8	2,056	"	46 26
11	2,018	"	45 40
16	4,066	"	91 48
18	2,030	"	45 68
24	4,020	"	90 45
	18,255		$410 73
May 1	2,016	2¼c.	$45 36
6	1,866	"	41 99
9	1,996	"	44 91
14	2,006	"	45 14
17	2,053	"	46 19
30	2,003	"	45 07
	11,940		$268 66
June 14	2,021	2¼c.	$45 47
19	2,046	"	46 03
26	2,047	"	46 06
	6,114		$137 56
July 10	2,023	2¼c.	$45 52
	2,023		$45 52

Date.	Pounds.	Price.	Value.
1872.			
Aug. 1	2,060	2¼c.	$46 35
5	2,017	"	45 38
9	2,051	"	46 15
14	2,023	"	45 52
21	2,040	2c.	40 80
28	2,058	"	41 16
	12,249		$265 36
Sept. 4	2,040	2c.	$40 80
10	2,015	"	40 30
14	2,049	"	40 98
17	2,035	"	40 70
25	2,037	"	40 74
	10,176		$203 52
Oct. 1	2,057	2c.	$41 14
5	2,036	"	40 72
11	2,046	"	40 92
16	2,034	"	40 68
21	2,036	"	40 72
25	2,065	"	41 30
30	1,948	"	38 96
	14,222		$284 44
Nov. 1	1,946	2c.	$38 92
5	2,057	"	41 14
7	2,019	"	40 38
11	2,039	"	40 78
12	3,989	"	79 78
20	2,007	"	40 14
23	2,010	"	40 20
26	2,001	"	40 02
29	2,039	"	40 78
	20,107		$402 14
Dec. 4	20,43	2c.	$40 86
6	1,945	"	38 90
9	2,022	"	40 44
11	2,047	"	40 94
16	2,044	"	40 88
19	2,023	"	40 46
23	2,037	"	40 74
26	2,019	"	40 38
27	2,038	"	40 76
31	2,019	"	40 38
	20,237		$404 74

Date.	Pounds.	Price.	Value.	Date.	Pounds.	Price.	Value.
1873.				1873.			
Jan. 2	2,016	2c.	$40 32	May 6	2,077	2½c.	$51 92
6	2,046	"	40 92	8	2,048	"	51 20
9	2,039	"	40 78	13	2,056	"	51 40
11	1,862	"	37 24	19	2,048	"	51 20
14	2,030	"	40 60	22	2,071	"	51 77
17	1,895	"	37 90	24	2,037	"	50 92
20	2,008	"	40 16	29	2,019	"	50 48
22	2,007	"	40 14		14,356		$358 89
25	7,013	"	40 26				
29	2,007	"	40 14				
31	1,994	"	39 88	June 3	2,037	2½c.	$50 92
	21,917		$438 34	6	2,038	"	50 95
				12	2,056	"	51 40
Feb. 3	1,987	2c.	$39 74	16	2,029	"	50 72
6	2,033	"	40 66	19	2,064	"	51 60
8	2,028	"	40 56	24	2,026	"	50 65
11	2,068	"	41 36	28	2,081	"	52 02
14	2,016	"	40 32		14,331		$358 26
17	2,041	"	40 82				
19	1,972	"	39 44				
22	1,962	"	39 24				
25	2,009	"	40 18	July 25	140	2½c.	$3 50
28	2,030	"	40 60	29	146	"	3 65
	20,146		$402 92		286		$7 15
Mar. 3	1,988	2c.	$30 76				
6	2,024	"	40 48	Aug. 5	1,992	2½c.	$49 80
8	2,050	"	41 00	8	2,008	"	50 20
11	2,012	"	40 24	13	2,067	"	51 67
13	1,997	"	39 94	16	2,043	"	51 07
17	2,022	2½c.	42 96	20	2,018	"	50 45
21	1,939	"	41 30	23	2,077	2¾c.	57 11
25	2,042	"	43 39	26	2,011	"	55 30
27	2,015	"	42 82	29	2,060	"	56 70
	18,089		$371 89		16,276		$422 30
Apr. 1	2,088	2½c.	$43 09				
4	2,032	"	43 18				
5	2,017	"	42 86	Sept. 3	2,048	2¾c.	$56 32
9	2,036	2½c.	50 90	6	2,036	3c.	61 08
11	2,034	"	50 85	11	1,996	"	59 88
15	2,066	"	51 65	16	2,059	"	61 77
18	2,036	"	50 90	17	2,030	"	60 90
22	2,044	"	51 10	22	2,045	"	61 35
24	2,040	"	51 00	25	2,040	"	61 20
29	2,022	"	50 55	29	2,052	"	61 56
	20,355		$486 08		16,306		$484 06

1626 *"Complainant's Exhibit No. 1"*—Continued.

Date.	Pounds.	Price.	Value.
1873.			
Oct. 1	2,036	3c.	$61 08
6	2,090	"	62 70
11	2,066	"	61 98
16	2,048	"	61 44
18	2,053	"	61 59
22	2,045	"	61 35
27	2,059	"	61 77
	14,397		$431 91
Nov. 1	2,070	3c.	$62 10
5	2,051	"	61 53
7	2,011	"	60 33
10	2,060	"	61 80
12	2,029	"	60 87
14	2,026	"	60 78
17	2,055	"	61 65
19	2,055	2¾c.	56 51
22	2,031	"	55 85
25	2,035	"	55 96
29	2,064	"	56 76
	22,487		$654 14
Dec. 4	2,068	2¾c.	$56 87
10	2,032	"	55 88
12	2,082	"	57 25
15	2,095	"	57 61
17	2,036	"	55 99
20	1,992	"	54 78
24	2,061	"	56 67
27	2,052	"	56 43
29	2,052	"	56 43
30	2,032	"	55 88
	20,502		$563 79

Date.	Pounds.	Price.	Value.
1874.			
Jan. 2	2,036	2¾c.	$55 99
7	2,053	"	56 45
9	2,014	"	55 38
14	2,081	"	57 22
15	2,071	"	56 95
17	2,069	"	56 89
20	2,094	"	57 58
22	2,077	"	57 11
24	2,067	"	56 84
27	2,079	"	57 16
29	2,019	"	55 52
31	2,054	"	56 48
	24,714		$679 57
Feb. 4	2,033	2¾c.	$55 90
6	2,052	"	56 43
9	2,043	"	56 18
13	2,009	"	55 24
17	2,052	"	56 43
21	2,075	"	57 06
24	2,066	"	56 81
26	2,058	"	56 60
28	2,062	"	56 70
	18,450		$507 35
Mar. 3	2,054	2¾c.	$56 48
5	2,057	"	56 56
9	2,077	"	57 11
12	2,066	"	56 81
14	2,072	"	56 98
18	2,082	"	57 25
20	2,036	"	55 99
24	2,071	"	56 95
26	2,097	"	57 66
28	2,056	"	56 54
31	2,057	"	56 56
	24,725		$624 89
Apr. 3	2,078	2¾c.	$57 15
6	2,074	"	57 04
9	2,060	"	56 65
11	2,011	"	55 30
15	2,053	"	56 46
17	2,051	"	56 40
20	2,053	"	56 45
24	2,066	"	56 82
27	2,058	"	56 60
29	2,063	"	56 73
	20,567		$565 60

Date.	Pounds.	Price.	Value.
1874.			
May 1	2,064	2¾c.	$56 76
5	2,069	"	56 90
7	2,072	"	56 98
11	2,069	"	56 90
13	2,075	"	57 06
19	2,056	"	56 54
21	2,067	"	56 84
26	2,059	"	56 62
29	2,059	"	56 62
	18,590		$511 22
June 4	2,057	2¾c.	$56 56
9	2,087	"	57 39
15	2,019	"	55 52
17	2,121	"	58 32
19	2,054	"	56 48
25	2,071	"	56 95
	12,409		$341 22
July 2	1,464	2¾c.	$40 26
	1,464		$40 26
Aug. 13	904	2½c.	$22 60
15	2,055	"	51 38
18	2,064	"	51 60
21	2,056	"	51 33
26	2,058	"	51 45
29	2,045	"	51 13
	11,182		$279 49
Sept. 2	2,053	2½c.	$51 33
4	2,054	"	51 35
9	2,073	"	51 83
11	2,057	"	51 43
15	2,069	"	51 73
16	2,105	"	52 63
18	2,159	"	51 48
21	2,081	"	52 02
23	2,076	"	51 90
25	2,067	"	51 67
28	2,087	"	52 18
30	2,061	"	51 53
	24,842		$621 08
1874.			
Oct. 1	2,089	2½c.	$52 22
3	2,052	"	51 30
6	2,054	"	51 35
8	2,100	"	52 50
9	2,036	"	50 90
12	2,067	"	51 67
14	2,086	2⅓c.	46 94
14	2,069	"	46 55
17	2,097	"	47 18
20	2,063	"	46 42
22	2,066	"	46 49
24	2,063	"	46 42
28	2,077	"	46 73
30	2,047	"	46 06
	29,066		$682 73
Nov. 2	2,068	2⅓c.	$46 53
5	2,057	"	46 28
9	2,077	"	46 73
11	2,056	"	46 26
13	2,068	"	46 53
16	2,061	"	46 37
18	2,048	"	46 08
19	2,057	"	46 28
21	2,024	"	45 54
23	2,049	"	46 10
25	2,080	"	46 80
28	2,040	"	45 90
	24,685		$555 40
Dec. 2	2,060	2⅓c.	$46 35
4	2,073	"	46 64
7	2,067	"	46 51
9	2,083	"	46 87
12	2,034	2c.	40 68
14	2,055	"	41 10
17	2,032	"	40 64
19	2,066	"	41 32
22	2,058	"	41 16
24	2,020	"	40 40
28	2,051	"	41 02
29	2,081	"	41 62
31	2,043	"	40 86
	26,723		$555 17
1875.			
Jan. 2	2,043	2c.	$40 86
5	2,064	"	41 28
6	2,056	"	41 12
	6,163		$123 26

Grand total, 789,732 lbs., $19,955.36.

1628 "COMPLAINANT'S EXHIBIT No. 2."

Glycerine Statement.

Glycerine produced from May 1, 1870, to January 8, 1875, inclusive.

Date.	No. of bbls.	Price.	Value.
1870.			
May	1,282	93¾c.	$1,201 87
June	1,524	"	1,424 94
Sept.	1,386	"	1,299 37
Oct.	1,421	"	1,332 18
Nov.	1,334	"	1,250 62
Dec.	1,094	"	1,025 62
	8,041		7,534 60
1871.			
Jan.	1,102	93¾c.	$1,033 12
Feb.	1,314	"	1,231 87
March	1,564	"	1,466 25
April	1,395	"	1,307 80
May	1,436	"	1,346 25
June	1,269	"	1,189 68
August	1,327	"	1,244 05
Sept.	1,242	"	1,164 37
October	1,069	87½	935 37
Nov.	1,787	1 50	2,680 50
Dec.	1,461	1 62½	2,374 12
	14,966		$15,973 37
1872.			
Jan.	1,120	1 62½	$1,820 00
Feb.	770	"	1,251 25
March	1,592	"	2,587 00
April	1,337	"	2,172 62
May	1,030	"	1,673 75
June	651	"	1,057 88
July	523	"	849 87
August	1,234	"	2,005 25
Sept.	1,247	"	2,026 37
Oct.	1,311	"	2,130 32
Nov.	1,450	"	2,356 25
Dec.	1,437	"	2,335 12
	13,702		$22,265 68

Date.	No. of bbls.	Price.	Value.
1873.			
Jan.	1,485	1 62½	$2,413 12
Feb.	1,341	"	2,179 12
March	1,344	"	2,184 00
April	1,367	"	2,221 37
May	1,277	"	2,075 13
June	1,146	"	1,862 25
August	1,017	"	1,652 62
Sept.	1,166	"	1,894 75
October	1,330	"	2,161 25
Nov.	982	1 78	1,156 92
	293	2 35½	690 20
Dec.	1,314	"	3,096 11
	14,062		23,586 84
1874.			
Jan.	1,497	2 27	3,395 12
Feb.	1,099	2 35½	2,591 15
March	1,467	"	3,456 61
April	1,447	"	3,409 50
May	1,170	"	2,756 45
June	1,033	"	2,433 82
August	715	"	1,683 82
Sept.	1,457	"	3,432 87
October	1,572	2 17½	3,419 60
Nov.	1,363	2 35½	3,211 02
Dec.	1,376	"	3,242 20
1875.			
Jan. 1 to 8 inclusive	345	2 17½	750 37
	14,541		33,782 53
Total	65,312		$103,143 03

Amount and Value of Stock Saponified

Date.	Tallow.			Grease.			Stearine.			Prime	
	Pounds.	Price.	Value.	Pounds	Price	Value.	Pounds.	Price.	Value.	Pounds.	Price.
1870.		Cts.			Cts.			Cts.			Cts.
May	161,000	9	14,490 00	175,157	8½	$14,888 35					
June	217,558	9	19,580 12	230,891	8½	19,625 73					
Sept.	161,007	10	16,100 70	213,506	8½	18,148 01					
Oct.	161,000	9½	15,295 00	209,577	8½	17,814 05					
Nov.	202,411	9	18,216 99	192,755	7¾	14,938 52					
Dec.	178,052	9	16,024 68	170,785	7¾	13,235 84					
	1,0 1,028		$99,707 59	1,192,671		$98,650 50					
1871.											
Jan	224,079	8¾	$19,606 91	79,496	7¾	$6,160 94					
Feb.	263,261	8¾	23,035 34	73,611	7¾	5,704 85	92,068	8	$7,365 44		
March	219,987	8¾	19,248 86	96,317	7¾	7,464 57	95,120	8¼	7,847 40		
April	149,754	8¾	13,103 47	125,631	7¾	9,265 29	92,826	8¼	7,658 15		
May	235,056	8½	19,979 76	89,545	7¾	6,603 94	25,083	8	2,006 64		
June	115,938	8¼	9,564 89	187,509	7	13,125 63	85,693	7½	6,426 98		
July	146,731	8½	12,472 13								
Aug.	178,437	8½	15,167 15				13,826	8	1,106 08		
Sept.	185,675	8½	15,782 37	110,892	7	7,762 44					
Oct.	217,652	8½	18,772 49	42,395	6¾	2,861 66	63,135	8	5,050 80	12,912	9
Nov.	126,539	9	11,387 70	108,244	6¾	7,304 27	4,916	8½	417 86	19,329	8¾
Dec.	226,958	8¾	19,858 83	38,454	6¾	2,588 90	45,368	7	3,175 76	49,931	8½
	2,290,058		$197,979 90	949,994		$68,842 49	518,035		$41,055 11	258,172	
1872.											
Jan	124,098	8¾	$10,858 58	60,473	6¾	$4,081 93	51,073	7½	3,830 48	38,287	8
Feb.	21,296	8½	1,814 19	24,045	6½	1,621 42	18,652	7	1,305 64	13,869	8¼
March	205,515	8½	17,725 67	60,221	6½	3,914 36	5,973	8	477 84	1,184	8¼
April	240,270	8½	20,422 95	118,946	6¾	8,028 85					
May	196,532	8¾	17,196 55	150,455	6¾	10,155 71					
June	199,215	8¾	17,431 31	67,948	6¾	4,586 49					
July	70,547	8¾	6,170 24								
Aug.	476,574	8½	42,295 94	25,771	6	1,546 26					
Sept	389,382	9	35,044 38	14,408	6¼	900 50					
Oct.	422,922	9	38,062 98	134,227	6¼	8,389 19					
Nov.	343,619	8¾	30,066 66	59,867	6¼	3,741 69	119,443	7¾	8,808 92		
Dec.	357,866	8¼	29,523 95	62,855	6	3,771 30	206,546	7¾	15,232 77		
	3,047,776		$266,633 40	780,116		$56,737 70	401,687		$29,655 65	53,531	

EXHIBIT No. 3."

May 1st, 1870, *to December 31st*, 1872.

stearine.	Bleached stearine.			Grease stearine.			W. G. stearine.			Cotton-seed stearine.		
Value.	Pounds.	Price.	Value.	Pounds.	Price.	Value.	Pounds.	Price.	Value.	Pounds.	Price.	Value.
		Cts.			Cts.			Cts.			Cts.	
$1,162 08	14,055	8	$1,124 40									
17,091 29	82,618	8	6,609 44									
4,244 13	29,502	8	2,360 16									
$22,497 50												
$3,062 96	65,910	7	$4,613 70									
1,143 45	172,465	7	12,072 55	46,312	7	$3,241 84	9,475	7¾	$734 31			
97 68	148,316	7½	11,123 70	20,604	7	1,442 28						
.....	83,159	7½	6,236 92									
.....	32,255	7½	2,419 13									
.....	.....	....	.....	.....	....	.....	.....	....	.....	12,866	7	$902 02
.....	.....	....	.....	.....	....	.....	.....	....	.....	9,779	6	587 94
$4,304 09	502,105		$36,466 00	66,916		$4,684 12	9,475		$734 31	22,685		$1,489 96

Amount and Value of Stock Saponified January 1st, 1873, to January 9th, 1875.

Date.	Tallow.			Grease.			Stearine.			Tallow grease.		
	Pounds.	Price.	Value.	Pounds.	Price.	Value.	Pounds.	Price.	Value.	Pounds.	Price.	Value.
1873.												
Jan.	286,441	8½ cts.	$23,273 33	116,282	6½ cts.	$7,267 63	124,591	7¼ cts.	$9,032 85			
Feb.	263,519	8¼ "	21,740 32	140,890	6¼ "	8,805 63	173,659	7¼ "	12,590 28			
March	289,187	8¼ "	23,857 93	103,337	6¼ "	6,458 56	110,764	7¼ "	8,030 39			
April	333,073	8¼ "	27,478 52	101,885	6¼ "	6,367 81	97,553	7¼ "	7,072 59	10,230	6 cts.	$613 80
May	356,115	8¼ "	29,379 49	157,702	6¼ "	9,856 38						
June	284,184	8 "	22,734 72	104,958	6¼ "	6,559 87						
Aug.	297,904	8 "	23,832 32	98,511	5½ "	5,418 10						
Sept.	271,606	8 "	21,728 48	111,196	5¾ "	6,393 77						
"	7,655	7 "	535 85									
Oct.	244,166	8 "	19,533 28	142,404	5½ "	7,832 22						
Nov.	372,812	7 "	26,096 84	243,794	5½ "	13,408 67						
Dec.	379,880	7 "	26,591 60	186,931	5¾ "	10,748 53						
	3,386,542	------	$266,782 68	1,507,890	------	$89,117 17	506,567	------	$36,726 11	10,230	------	$613 80
1874.												
Jan.	458,295	7¼ "	$33,226 39	165,967	6 "	$9,958 02						
Feb.	398,199	7¼ "	28,869 42	106,646	6¼ "	6,665 38						
March	399,552	7¼ "	28,967 52	178,342	6¼ "	11,146 38						
April	396,887	7¼ "	28,774 31	197,849	6¼ "	12,365 56						
May	414,381	7½ "	31,078 57	224,770	6½ "	14,610 05						
June	328,579	7⅝ "	25,054 15	85,944	6½ "	5,586 36						
Aug.	203,461	8¼ "	16,531 21	81,615	6½ "	5,304 97						
Sept.	548,390	8¼ "	47,984 12	121,373	6¾ "	8,192 68						
Oct.	645,814	8¼ "	57,315 99	189,950	6⅞ "	13,059 07						
	20,250	7½ "	1,518 75									
	675	7 "	47 25									

Nov.	521,638	8⅞	46,295 37	84,024	6¾	5,671 62						
Dec. to Jan. 9, 1875	564,413	8¾	49,386 14									
	212,466	8¾	18,590 78	61,844	7⅛	4,483 69						
	5,113,000		$413,639 97	1,498,324		$97,043 78						

Grand Total.

Tallow	14,918,404 pounds.	$1,244,743 54
Grease	5,928,995 "	404,391 64
Stearine	1,426,289 "	107,436 87
Prime stearine	311,503 "	26,801 59
Bleached "	628,280 "	46,560 00
Grease "	66,916 "	4,684 12
White grease stearine	9,475 "	734 31
C. S. "	22,685 "	1,489 96
Tallow grease	10,230 "	613 80
	23,322,777 pounds.	$1,837,455 83

Average per pound, 7.88 cents.

"COMPLAINANT'S EXHIBIT No. 4."

Lime Statement.

Lime used in saponification, May, 1870, through January 8th, 1875.

Date.	Barrels.	Cost.	Freight.
1870.			
May	30	$22 50	
June 30			$30 00
Sept. 7	30	22 50	
Oct. 29	30	22 50	
Nov. 30			1 05
1871.			
Mar. 29	15	11 25	
31			11 00
April 6	6	4 50	
22	30	22 50	
29			5 75
May 31			13 00
July 3	6	7 50	
25	15	11 25	
Aug. 12	7	8 75	
Sept. 30			9 75
Oct. 24	37	27 75	
31	10	12 50	
Nov. 23	5	6 25	
28	15	11 25	
30			5 25
Dec. 2	30	22 50	
9	15	11 25	
30	15	11 25	10 50
1872.			
Jan. 22	15	11 25	
31	6	4 50	
Feb. 27	24	18 00	
Mar. 11	14	17 50	
30			1 59
Ap'l 22	28	35 00	
29	15	11 25	
30			13 50
May 22	15	11 25	
31			4 50
June 10	15	11 25	
29			6 50
July 31	15	11 25	
Sept. 28	17	12 75	
30			3 40
Oct. 24	15	11 25	
31	15	11 25	11 00
Nov. 5	6	7 50	
22	14	10 50	
30			2 78
Dec. 28	43	32 25	
31			10 75
1873.			
Jan. 2	11	$13 75	
Feb. 28	30	22 50	
Mar. 3	31	38 75	
1			$6 00
26	30	22 50	
31			10 50
April 1	10	12 50	
30			11 83
May 1	15	11 25	
30	15	11 25	
31			5 25
June 3	5	6 25	
July 10	10	12 50	
30	15	11 25	
31			5 25
Aug. 1	1	1 25	
Sept. 30	15	11 25	
Oct. 4	15	18 75	
31	30	22 50	
	30	18 00	
Nov. 26	8	10 00	
Dec. 1			10 25
31			12 00
1874.			
Jan. 24	60	36 00	
31			12 60
Feb. 28			12 00
16	30	18 00	
Mar. 31			12 00
Ap'l 30			12 00
May 4	60	36 00	
30			9 00
June 12	3	3 75	
July 7	30	18 00	
31			10 50
Aug. 31			9 00
Sept. 22	60	36 00	
Nov. 13	60	36 00	
Total	1,127	$880 75	$278 50

Cost	$880 75
Freight	278 50
Drayage, 10 cts. per bbl.	112 70
	$1,271 95

1632 "COMPLAINANT'S EXHIBIT NO. 5."

"Collier and Werk Guaranty."

Whereas Proctor & Gamble, of Cincinnati, Ohio, manufacturers of candles, have been and now are licensees of Richard A. Tilghman, of Philadelphia, under letters patent granted to said Tilghman on the third day of October, A. D. 1854, and extended for seven years from the 9th day of January, A. D. 1868; and whereas the said Proctor & Gamble, having consulted counsel, and being advised that said Tilghman has, in fact, no valid or equitable claim against them, are determined to resist his demands in future and test the question of their liability in the courts, and for this purpose have employed Chas. B. Collier, Esq., of Philadelphia, as their solicitor: Now, therefore, this agreement, made and entered into on this fifteenth day of *May* June, A. D. 1870, by and between the said Proctor & Gamble and the said Collier, witnesseth as follows:

First. The said Proctor & Gamble agree to pay to said Collier at the signing of these articles a retaining fee of five hundred dollars ($500.00), and further agree to pay said Collier forty-five hundred dollars (4,500.00) so soon as said Proctor & Gamble are relieved from further payment and liability to said Tilghman under the said patent, as the result of any suit at law or in equity or otherwise. But if said Proctor & Gamble are not so relieved they shall not be liable to said Collier beyond said retaining fee of $500.00.

Second. The said Collier, for the consideration named, does hereby agree to give and render to said Proctor & Gamble his best legal services in defense of any suit or proceeding that may be instituted against them by said Tilghman, and will endeavor to the ex-
1633 tent of his ability to obtain their release and discharge from further liability to said Tilghman.

Third. The said Collier does hereby guarantee the said Proctor & Gamble that their liability to said Tilghman shall not exceed the amount stipulated in their contract with him, said Tilghman, with interest on the payments from the time the same would be due under said contract; and, moreover, that their liability for costs of suit shall not exceed the amount of two hundred dollars ($200.00), and that he, said Collier, will save them harmless as against liability to said Tilghman beyond the amount provided in their said contract, with interest and costs, in excess of $200.00.

In witness whereof the said Proctor & Gamble and the said Chas. B. Collier have hereunto subscribed their names in duplicate the day and year last aforementioned.

CHAS. B. COLLIER.
PROCTOR & GAMBLE.

Internal revenue certificate.
U. S.
P. & G.
June
15, '70.
Five cents.

[*I do further state that it has not been my intention or purpose, nor is it my intention or purpose to institute any suit against Proctor & Gamble for any supposed infringement by them of my patent, nor do I know of any intention or purpose on the part of any person to institute any suit against them.*]

I, Michael Werk, do hereby guarantee the fulfillment by said Charles B. Collier of his part of the foregoing contract, and particularly that part thereof embraced in the third (3) or last section.

M. WERK.

1634 "COMPLAINANT'S EXHIBIT NO. 6."

The American Journal of Pharmacy, vol. 51, pages 289-291.

Glycerine—its Early Manufacture in this Country. By Robert Shoemaker.

I have thought it might be interesting to the readers—especially the younger portion—of the Journal to be told something of the introduction of this manufacture in the United States.

I claim to have made the first glycerine, produced for sale, or as an article of commerce, and it came about in this wise.

In the year 1837 I commenced in this city the preparation of the plasters of the United States Pharmacopœia, and sold them (chiefly in rolls of half a pound) to the druggists in this city first, and afterward throughout the country. Machine-spread plasters (except adhesive, on cloth) came later, and I may have something to say of these in a future paper.

The base of all, or nearly all, of these plasters was emp. plumbi, of which I manufactured large quantities.

About the time my late much esteemed friend, Wm. Procter, Jr., was preparing the matter for his "Mohr, Redwood, and Procter's Pharmacy," he asked permission to examine my apparatus for the manufacture of lead plaster, with a view of writing an article for his forthcoming book. This request I freely granted, and the result of his visit to my laboratory may be found on page 420, etc., of that book, edition of 1849. At the time of the visit of Mr. Procter we were busily engaged in dipping out the newly made emp.
1635 diach., and cooling it by kneading and pulling in cold water. This water, when it became warm, was allowed to run to waste, carrying with it what glycerine it had extracted from the plaster.

Mr. Procter asked me if I could not make him some glycerine, "at least enough for a specimen for the class," adding "here is a great waste." I had often tested the water sweetened by the glycerine, but as there was at that time no demand for the article, this "waste" was allowed.

I at once set about producing the specimen for Prof. Procter, as near as I can remember, taking about five gallons of water in which

NOTE.—The portions of the exhibit which are printed between brackets and in *italics* are erased in the original.

lead plaster had been kneaded and cooled. I turned it into an evaporating can (jacketed), passed on the steam, keeping it below the boiling point, evaporated the fluid to the consistence of a thin syrup. Transferring this to a glass vessel, a current of sulphureted hydrogen was passed through it to precipitate the oxide of lead held in solution, then filtered it, and my glycerine was completed. Of this, my first effort, I sent Mr. Procter a part, retaining the balance, which was often shown as a curiosity.

This was about the year 1846. Although glycerine had been discovered by Scheele more than 60 years before that time, it had not come into use (at least in this country), and there was no demand for it.

After this (about 1848) I made a large quantity, it having been recommended in a French medical journal as a curative in pulmonary affections. The paper was translated, and appeared in one or more of our medical journals. It came to be prescribed by some of our physicians.

Looking back over my books, I find the first entry charging glycerine under date of "6th mo., 1st, 1848," and this was to Edward Parrish, then at the northwest corner of Chestnut and Ninth streets. The quantity was small, only one quarter of a pound, and the price charged was $4.00 per pound. The next sale was to a New York house, at same price, and for a larger quantity. The entire product sold in 1848 was about fifteen pounds. In 1849 I reduced the price to $3.00 per pound, and it remained steadily at this figure
1636 until near the close of 1850, when it fell to $2.75. The quantity sold in 1849 was about two hundred pounds. The demand rapidly increased, and in 1850 the quantity sold was much larger, but I find no charge at a less price than $2.70 per pound.

I find sales entered to druggists (beside those in this city) in New York, Boston, Providence, Baltimore, Louisville, New Orleans, etc. The greatest demand, however, came from our own wholesale houses, the manufacturing chemists being the largest buyers. Glycerine now began to be imported from England (Price's), and sold at a price below what it cost me to produce it, and so I gradually ceased to make it. This English article was made from "soap liquor."

When I first commenced making glycerine the quantity of lead plaster manufactured gave me for one or two years all that I needed; but soon I made the plaster for the sake of the glycerine alone, and I remember at one time I had many hundredweight of plaster in mass, from which I had taken the glycerine, and for which there was no sale, so that the plaster and not the glycerine became the refuse product.

In looking over my books for facts connected with this article my mind was saddened by reading the names of many who thirty years since were actively engaged in the prosecution of their profession, but who now "sleep the last sleep." Referring to a few in our city alone, I meet such names as Charles Ellis, Edward Parrish, Wm. Procter, Jr., Elias Durand, Frederick Brown, Tristram Needles, Joseph and John Reakirt, Frederick Klett, John K. and George K.

Smith, Edward and Charles Yarnell, Geo. D. Wetherill, the Roberts, Lennings, Cressons, and many others.

It is an interesting study comparing the small beginnings as related above (only a generation back) with the immense production of glycerine at the present day. So far as I am informed, all that I made and sold was used medicinally, either internally administered or in form of lotion or unguent.

1637 At this day, vast quantities are used in the manufacture of nitro-glycerine, dynamite, duallin, and other explosives. The perfumers are large consumers, also the confectioners. Large quantities are used for the preservation of fruit and meat, as well as in the preparation of chewing tobacco.

But the greatest demand comes, perhaps, from the brewers. It is estimated that over forty thousand pounds is drank annually in beer in this country alone; and instead of my old price of $4.00 per pound, an article quite as good can now be produced for 18 cents per pound.

Philadelphia, April, 1879.

"COMPLAINANT'S EXHIBIT No. 7."

Bullock & Crenshaw Purchase-Book.

(This exhibit is printed at the end of Charles Bullock's testimony, record, page 63.)

1638 "COMPLAINANT'S EXHIBIT No. 8."

Wilson's Lecture.

On a New Process of Obtaining and Purifying Glycerine, by George Fergusson Wilson, Esq., F. R. S. (Part of this paper was read at the Glasgow meeting of the British Association for the Advancement of Science, September, 1855.)

The paper I was asked to give was one on our new process of obtaining and of purifying glycerine. I trust, however, you will excuse, as an introduction, a short sketch of the past history of glycerine and its uses, though it will take us over some ground well known to most members present.

Glycerine was discovered in 1789 by Scheele, as a product in the process of lead-plaster making, and was called by him the sweet principle of oils. About twenty-five years afterwards it was studied by the father of fatty chemistry, Chevreul, and shown by him to be the base of fats and fat oils. M. Chevreul lately received a specimen of glycerine, obtained by our new process, with expressions of extreme pleasure. Nearly half a century has passed since the earliest of those beautiful researches into the constitution of fatty bodies, in the course of which he discovered the function of glycerine, yet our specimen found him still lecturing to his class.

A source of impure glycerine has long existed in the preparation of lead-plaster, in which the combination of the litharge with the acids of the olive oil sets the glycerine free; another source in soap-

making, the soda or potash setting free the glycerine, and a third source in the stearic candle manufacture, where the lime saponification separates the glycerine. Most of the purifiers of glycerine appear to have preferred this last source.

1639 Notwithstanding the known existence of these great sources of impure glycerine, it was long before glycerine was in any way utilized; hundreds of tons have been and are yearly thrown away.

The first suggestion of a use which we can trace dates in the beginning of 1844, when Mr. Thomas de la Rue, being engaged on several experiments requiring the use of syrupy substances, procured some glycerine from Mr. Warington, of Apothecaries' Hall, some of which he applied to a burn and an irritation of the skin. The experience thus obtained of its properties of soothing and keeping moist led to its introduction, through Mr. Startin, into the Hospital of Skin Diseases, where it soon came into extensive use.

In 1846 Mr. Warington took out a patent for the use of glycerine as an agent in preserving animal and vegetable substances, and tried many experiments on preserving meat. He informs me that part of a neck of mutton preserved in glycerine for several months, when cooked by Soyer, was partaken of by a gentleman with great satisfaction.

Mr. Warington, I believe, first applied glycerine in mounting objects for the microscope, for which it has proved so successful.

In the Lancet of June, 1849, Mr. Thomas Wakley published the results of a year's experience in a long and very interesting paper on the "Use of Glycerine in Diseases of the Ear," giving a number of cases in which it had proved a cure for deafness. In the number of the 23d of the same month his results were confirmed by letters from Mr. Erasmus Wilson and Dr. Gardner, the latter of whom drew attention to the fact that glycerine should be free not only from any trace of lead, but also as much as possible from water. His theory was, however, better than his practice, for the glycerine he speaks of using, s. g. 1.280, being above the density of anhydrous glycerine, must have been impure.

Isolated application of glycerine had thus been suggested, but M. Cap appears to have been the first to see its extraordinary

1640 value in a great variety of medicinal preparations. His very valuable and interesting papers were published in the Annales de Pharmacie et de Chimie, and translated into the Chemist I shall give two short extracts from them.

M. Cap in his first paper (Journal de Pharmacie et de Chemie, February, 1844, Chemist, April, 1854), begins by attacking the process of purifying glycerine given in the French chemical books, and shows its defects. He then gives his own process, remarks upon the great value of glycerine in skin diseases, and after suggesting a number of valuable uses proceeds as follows:

"Glycerine dissolves the vegetable acids, the deliquescent salts, the sulphates of potassa, soda, and copper, the nitrates of potassa and silver, the alkalines, chlorides, potassa, soda, baryta, strontia, bromine, iodine, and even oxide of lead. It dissolves or suspends the vegeta-

ble alkaloids in the same manner as the aqueous liquids, and at the same time the resulting products may be used for the same purposes as though mixed with oil. Thus the salts of morphia dissolved in it completely, even cold, in all proportions. Sulphate of quinine in the proportion of $\frac{1}{10}$ dissolves in it when hot, but when cold separates into clots, which, when triturated with the supernatant liquid, give it the consistence of a cerate very useful for frictions and embrocations. It is the same with the salts of brucine, strychnine, veratrine, and most preparations of the same order, which enables us to consider that we have now if not medicinal oils with a vegetable alkaloid base, at least a series of new preparations which will fulfill a perfectly analogous use in therapeutics."

M. Cap, in his second paper (Chemist, October, 1854), states that he employed glycerine of 28 Baumé, or containing 88 per cent. of anhydrous glycerine, and speaks of it as a solvent of sulphuret of potassium and sulphuret of lime, of iodine, iodide of sulphur, iodide of potassium, iodide of mercury, of some chlorides, and of quinine and sulphate of quinine..

In the Chemist of February, 1855, Dr. Crawcour, of New
1641 Orleans, states that for twelve months past he had been in the habit of using glycerine very extensively in those cases requiring cod liver oil, in which the nauseous taste of the latter medicine rendered its exhibition impossible, and that now, in his practice, it had entirely superseded cod liver oil.

In a paper read at the meeting of the Royal Institution of the 30th of March, 1855, by the Rev. John Barlow, F. R. S., attention was again drawn to the great preservative power of glycerine upon meat. On this occasion Mr. Barlow showed specimens of flesh which had been immersed, some partially and some wholly, in glycerine for more than a month. I can answer for the flesh having appeared to be perfectly fresh.

M. Cap worked upon the waste liquors of soap and stearic candle works, which liquors he had first to concentrate. His process was shortly this: He used sulphuric acid to separate the lime, and continued boiling and agitation to drive off the volatile fat acids, removing any excess of sulphuric acid by means of carbonate of lime, allowing the liquor to cool at different densities, so as to deposit sulphate of lime, and, after final concentration, treating and filtering with washed animal charcoal. M. Cap's process, though an undoubted improvement, was not perfect, as glycerine so purified is always liable to contain more or less of salts of lime. And some glycerine, purified in our laboratory, according to M. Cap's directions, contained, in addition, volatile fat acids, and though the process was known in this country specimens of the so-called "pure" glycerine, obtained from the best sources in London as recently as last January, contained in every case more or less impurity.

The best specimen came from Edinburgh, but even this was not absolutely free from impurity. Some medical men appear to have been afraid to prescribe glycerine for internal use, sometimes with reason, as appears from the Chemist of May, 1855, when Mr. Hamilton, of Liverpool, referring to the papers of MM. Cap and Garot, and

of Dr. Crawcour, stated that no doubt the glycerine purified and used by them might be safely used internally, but that, having doubts about the purity of the glycerine commonly sold as "pure glycerine," he had procured samples from several of the most respectable chemists in Liverpool, and on examination had detected lead in considerable quantity, and that the specimen in which he detected the largest quantity of lead was labeled "pure glycerine," was sold at double the price of the common glycerine, and was warranted free from lead.

1642

I will now proceed to describe the new process for obtaining and purifying glycerine, and may remark that the road by which we arrived at pure glycerine was a rather circuitous one. Our first step was to do away with the lime process of saponification, and with it our only source of impure glycerine. By our first improvement in separating the fat acids from neutral fats the glycerine was decomposed by the direct action of concentrated sulphuric acid at a high temperature, and all that remained of it was a charred precipitate. A new process for decomposing neutral fats by water under great pressure, coming under our notice, led us to look again more closely into our old distilling processes, and the doing this showed what we had often been on the brink of discovering, that glycerine might be distilled.

In our new process the only chemical agents employed for decomposing the neutral fat and separating its glycerine are steam and heat, and the only agents used in purifying the glycerine thus obtained are heat and steam. Thus all trouble from earthy salts or lead is escaped.

Distillation, however, purifies the impure glycerine of the old sources.

On the table is a series of products of palm oil, which will serve to illustrate the process. Steam, at a temperature of from 550° to 600° Fahr., is introduced into a distillery apparatus containing a quantity of palm oil. The fatty acids take up their equivalents of water, and the glycerine takes up its equivalent. They then distill over together. In the receiver the condensed glycerine, from its higher specific gravity, sinks below the fat acid. Sufficient steam must be supplied and the temperature regulated; otherwise the elements of the glycerine do not take up their equivalent of water, and acroleine is evolved—a body of a very different character, an acrid, eye-inflaming vapor, appreciated only by those who have had the misfortune of an experimental acquaintance with it.

1643

In an ordinary apparatus the glycerine distilled from the neutral fat is not in a sufficiently concentrated state for most purposes. It should therefore be concentrated and, if discolored, be redistilled. It is then obtained in the state of the specimen on the table at the temperature of 60° Fahr.; it is of s. g. 1.240, and contains 94 per cent. of anhydrous glycerine. It can be concentrated to s. g. 1.260, or to contain 98 per cent.

I have now to mention some uses for glycerine which I believe to be new, or to which I have seen distilled glycerine applied.

A possible use, which appears worthy of experiment, is to inject it into the bladder for the purpose of dissolving calculous deposits. From its blandness it should not cause irritation, while, as it is a solvent of urea and phosphate of lime, it might dissolve them when in the bladder. Some of the high authorities have received glycerine for the purpose of the experiment.

The use of glycerine in photography having been suggested, some distilled glycerine has been sent to several of the best photographers and makers of photographic preparations. It was very well received and considered to promise well, and is still the subject of many experiments, but as yet it does not appear that any great results have been arrived at. It is, however, expected to supersede the honey of Shadbolt's process.

The properties of soothing and keeping moist the skin have caused it to be used upon chapped hands and sunburnt faces. It has been proposed as a substitute for syrup in preserving fruits. Mixed with alcohol or pyroxylic spirit, it has been proposed by Mr. Warren de la Rue as an economical fuel for spirit lamps. For some time past, in Edinburgh as in London, it has been used in skin diseases. It is now being tried in some cases of diseases of the mucous membrane of the stomach.

We have been informed that in the preparation of sev-
1644 eral medicines glycerine may be substituted for syrup or sugar, with the effect, not only of preserving the medicine in an active state and free from change, but also of very greatly improving its taste. Griffith's iron mixture has been mentioned to us as an instance of this.

Glycerine appears to give the means of preservation of some objects of natural history without change in their color. This is shown by the specimens of fish upon the table. Our first experiment was upon a brilliantly colored two-pound trout, caught in one of the Perthshire locks. Immediately on taking it from the water I poured a quantity of glycerine over it and wrapped it in a cloth. At night the fish was cleaned and immersed in glycerine. Next day it was again wrapped in a saturated cloth. On examining it a day or two afterwards in Edinburgh the color on the scales was unchanged. When it arrived in London part was steeped in water and then cooked. Though perfectly fresh and firm it had lost almost all its flavor. The uncooked portion was immersed in glycerine and sent to Professor Owen, who suggested that the brilliantly tinted fishes of the Coral islands and tropical coasts might be brought home in kegs of glycerine.

On the table are specimens of trout, roach, and perch, which have been, the trout more than two months, the perch and roach more than one month, in their bottles. It will be seen that the colors continue bright.

I may now state, in conclusion, that though a variety of uses, actual and possible, for pure glycerine have been mentioned, yet when we consider its power as a solvent, and at the same time its blandness and freedom from all irritant, exciting, acid, and fermenting properties, we must feel that not a tithe of its uses have yet been de-

veloped; that in glycerine there is a wide field open, requiring many scientific and practical labors, and which, once fully worked, will yield a tenfold crop of uses. Pure glycerine will then take its proper place among the most valued of modern products; and, produced as it will be in great quantities, it will be recognized in the arts as well as in medicine as a new real blessing to mankind.

1645 . "COMPLAINANT'S EXHIBIT No. 9."

Translation.

Comptes Rendues de l'Academie des Sciences, vol. 24, p. 247. Paris, February 15th, 1847.

Upon several detonating compounds produced with nitric acid and sugar, dextrine, lactine, mannite, and glycerine, by Mr. Ascagne Sobrero. (Extract from a letter to M. Pelouze.)

"I have seen in the last number of the Comptes Rendues of the Academy of Sciences, vol. 24, sitting of 25th January, 1847, that you, sir, have announced in the name of Messrs. Flores, Domonte, and Menard that mannite and the different kinds of sugar and gum furnished, by the action of nitric acid, compounds analogous to pyroxyline.

"I do not know to what point the researches of the two chemists whose discoveries you have announced have at present arrived; but certainly the idea of producing fulminating bodies by means of sugar and the analogous substances has been realized by me a long lime ago with cane sugar and dextrine. I have communicated a note upon this compound to the Academy of Turin the 30th January last.

"I will add also that I have already made an analysis of the fulminating sugar, and, although I have not been able to prevent the formation of oxygenated products of nitrogen during the combustion, the results which I have obtained would lead me to think that this compound would be sugar, $C^{12}H^{11}O^{11}$, less 2 equivalents of water, plus 2 equivalents of anhydrous nitric acid. This body has, in effect, furnished 3 per cent. of hydrogen and 21 per cent. of carbon.

"The composition of glycerine not being capable of being represented by carbon and water and its combinations with the fat
1646 acids, causing it to be considered almost as a base, and being on that account far removed from bodies analogous to sugar and cellulose (ligneaux), one could hardly suspect that it could give reactions analogous to those of the substances mentioned.

"However, the results that I have just obtained prove that glycerine is capable of giving, with a mixture of nitric and sulphuric acids, a substance analogous to fulminating cotton. This is what I can say of this substance and its properties.

"When one pours a mixture of 2 volumes of sulphuric acid f 66 degrees and 1 volume of nitric acid of 43 degrees into syrupy glycerine the reaction is very lively, but it is an action of oxydation, the products of which I have not examined. But if one keeps the

aforesaid mixture of the two acids in a freezing mixture, and pours into it the glycerine, stirring it, so as to prevent the rise of temperature, the glycerine dissolves promptly without visible reaction; if at this point one pours the mixture into water there precipitates an oily matter heavier than water, which collects at the bottom of the vessel, and which can be washed with an excess of water, so as to free it completely from acid without loss, seeing that it is insoluble in that substance. After the washings one can dissolve it completely in alcohol and precipitate it again by water, or we can dissolve it in ether and let this solution evaporate spontaneously. The ether being evaporated, one obtains the new substance isolated from matters which might make it impure. By keeping it in a vacuum over sulphuric acid for several days we can easily obtain it free from water. In this state this body has the appearance of olive oil of a slightly yellowish color; it is much heavier than water, in which it seems to be entirely insoluble; it dissolves, on the contrary, very well in alcohol and in ether.

"It is without odor, its taste is sweet, sharp, and aromatic. It is necessary to be careful in making this trial, for, on placing a very small quantity (as much as will moisten the end of the little finger) on the tongue, one experiences a violent headache during
1647 several hours. This action on the human body has been proved by several persons in my laboratory, and I have tried it many times on myself before I became certain that it has poisonous properties.

"I propose to analyze this substance as soon as possible. I foresee that it will be very difficult to conduct the combustion regularly, and that it will only be after many unsuccessful trials that I shall obtain results on which one can found a formula expressing its composition."

1648 DEFENDANTS' EXHIBIT No. 1.

Birnbaum-Dingler's Polytechnic, vol. 214, p. 56, and Musprat, 1877, vol. 4, p. 479.

Dingler's Polytechnic Journal, vol. 214, p. 56.

(On the quantity of neutral fat contained in fatty acid mixtures obtained by various methods of decomposing fats. By K. Birnbaum.)

A stearine-candle factory operated in our neighborhood caused me to repeatedly examine the products obtained by their manner of decomposing fats, and to determine especially the amounts of undecomposed fats contained in the fatty-acid mixtures.

As the investigations were carried out at a time when the factory replaced their old method of decomposing fat by the one proposed by J. C. A. Bock, results given below may aid in a comparison of the different methods used for the decomposition of fats.

The old method of the factory consisted in putting the melted fat and water in a strong copper vessel and heating the mixture until the pressure reached fourteen atmospheres.

The fat was subjected to this high pressure in contact with water for seven to ten hours at first. It was then washed to remove the liberated glycerine, and then, if possible, again submitted to treatment in the apparatus used for decomposition.

Since my investigations had shown that no complete separation of the fats into fatty acids and glycerine could be reached in this manner, the owners of the factory concluded to replace this old and by no means safe process by Bock's method, in which the
1649 decomposition of fat is reached by means of sulphuric acid, and without the use of pressure.

The figures given below prove that this new method is, in fact, preferable to the old one.

(The method of analysis is then given in full, but is not translated at present, because it occupies much space, and has no special relevancy. It is the best known at the time of the publication. H. E.)

"(*a.*) Inland tallow ten hours in the decomposition apparatus."

(Here follow details of weight, etc., used in the analysis, which, for brevity, I omit. H. E.)

"Therefore the composition of this fatty acid mixture was as follows:"

	Grammes.	
Water	0.0210 =	0.26 p. c.
Neutral fat	0.9093 =	10.90 "
Free fatty acids	7.3995 =	88.57 "
		99.73

"(*b.*) New York city fat, seven hours in decomposition apparatus at a pressure of 14 atmospheres."

8.222 grammes lost at 100° C. 0.032 grammes of water and yielded 8.1245 grammes fatty acids and 0.122 grammes of glycerine. The composition of the mixture, calculated from this, — as follows:

	Grammes.	
Water	0.0320 =	0.38 p. c.
Neutral fat	1.1800 =	14.37 "
Free fatty acids	6.945 =	85.17 "
		99.92

(*c.*) The same fat as in (*b*), decomposed twice, 7.773 grammes, lost at 100° C. 0.319 grammes of water, and yielded 7.690 grammes of fatty acids and 0.105 grammes of glycerine. The composition of the fatty-acid mixture was, therefore:

	Grammes.	
1650 Water	0.0319 =	0.41 p. c.
Neutral fat	1.0160 =	13.08 "
Free fatty acids	6.7180 =	86.44 "
		99.93

These figures show in the first place that under the conditions present in this practical operation as above described no complete decomposition of the fats could be reached by the above-mentioned older methods. Secondly, it follows that the decomposition of the fats progresses unequally; the decomposition of the neutral fats progresses during the first period of the process far more rapidly than in the latter.

Of New York city fat about 86 p. c. was decomposed during the first seven hours, and during the second seven hours but little more than 1 p. c.

I am sorry that I am obliged to content myself with presenting only this fact, because on account of the change in the process the factory was unable to send me samples taken at stated intervals during the first stage of the operation of the old process, an examination of which would have furnished an exact picture of the progress of the decomposition.

(*d.*) Fatty acid prepared by Bock's method:

5.914 grms. lost at 100° C. 0.025 grms. of water and yielded 5.886 grms. fatty acids. 3.102 grms. left on ignition 0.001 grm. ash.

The fatty-acid mixture had, therefore, the following composition:

Water	0.42 p. c.
Free fatty acids	99.53 "
Ash	0.03 "
	99.98

I found it impossible to separate even a trace of glycerine from this fatty-acid mixture, which was therefore completely free from neutral fat.

1651 Muspratt's Chemistry, by Kerl and Stohmann, 1877, vol. 4, p. 479.

Birnbaum in making comparative experiments as to the quantity of fatty acids obtained by the water saponification and Bock's methods, respectively states the following results:

	a	*b*	*c*	*d*
Free fatty acids	99.53	88.57	85.17	86.44
Neutral fat	----	10.90	14.37	13.08
Water	0.42	0.26	0.38	0.41
Ash	0.03			

(*a*) Fatty acid by Bock's method; (*b*) fatty-acid mixture treated at pressure of 14 atmospheres for 10 hours; (*c*) the same treated for 7 hours; (*d*) the same decomposed twice.

"DEFENDANTS' EXHIBIT NO. 2."

Berthelot-Wagner's Year Book, 1863, p. 665.

Berthelot's classical investigations on fats prove with certainty, as regards the necessity of a certain temperature, that if neutral fats

are at a certain temperature decomposed by water into fatty acids and glycerine at a lower temperature these products of decomposition may reunite, reproducing neutral fats.

1652 "DEFENDANTS' EXHIBIT No. 3."

Wagner's Year Book, 1864, page 630.

An apparatus similar in construction to the one proposed by Melsens has been in use during 1856 in the factory of Roubaix & Oudenkoven, in Antwerp, but had to be removed after one year on account of the difficulty of regulating the temperature and because losses and accidents could not be prevented (the pressure amounted to from 10 to 12 atmospheres). The fatty acids prepared in this apparatus were without fault in every regard.

To secure such good quality, however, the addition of from 1 to 2 p. c. of sulphuric acid was required. Without this addition they did not possess the crystalline appearance and dry feeling peculiar to fatty acids.

"DEFENDANTS' EXHIBIT No. 4."

Fownes, 1868, page 663.

The metallic salts of the fatty acids thus obtained are the well-known bodies called soaps, and the process is called saponification. This term, originally restricted to actual soap making, has been extended to all cases of the resolution of a compound ether into an acid and an alcohol; such, for example, as the conversion of ethyl-acetate into ethyl-alcohol by the action of alcoholic potash.

1653 "DEFENDANTS' EXHIBIT No. 5."

Allen, vol. 2, page 120.

Whenever an ether is split up into an acid and an alchohol the change is called saponification, no matter whether the agent effecting the change be steam, an acid, or a base. The term is even extended to the decomposition of ethers which do not yield fatty acids at all.

"DEFENDANTS' EXHIBIT No. 6."

Musprat, 1877, vol. 4, page 458.

C. Saponification with sulphuric acid and distillation of the liberated fatty acids.

"DEFENDANTS' EXHIBIT No. 7."

Erdman's Journal (Fremy) of Practical Chemistry, 1837, vol. 12, page 385.

(On the action of sulphuric acid on oils. By Edmond Fremy.)

It has long been known that sulphuric acid acts on oils and produces a kind of saponification.

The product of this reaction has even been called sulphate of soap. Macquer, for example, calls it sulphate of soap in his Dictionary of Chemistry.

1654 "DEFENDANTS' EXHIBIT No. 8."

Berthelot, Liebig, & Kopp Year Book, 1853, page 452.

Berthelot mentions the following compound of non-volatile fatty acids with glycerine, the formulæ of which we here report as he has given them, though the composition of some of the acids which are here discussed is differently given by other chemists:

Stearic acid heated for 26 hours to 200° C., with an equal weight of glycerine, forms mono-stearine $C^{42}H^{42}O^8=C^{36}H^{36}O^4+C^6H^8O^6-2\ HO$.

To remove the acid which has not entered into the composition, the solid substance floating on the excess of glycerine is removed and melted, and some ether and calcium hydrate are added. After heating this to 100° C. for a quarter of an hour, it is extracted with boiling ether. From this solution the mono-stearine is obtained as a white substance, very little soluble in cold ether, crystal-izes in small stellated groups of needles, which form globular knoss, and which melt at 61° C. and solidify again at 60° C., and which burn with a white bright flame. If stearic acid and glycerine in equal amounts are heated for 114 hours to 100° C., di-stearine is formed.

$C^{78}H^{78}O^{12}=2\ C^{36}H^{36}O^4H=C^6H^8O^6-2\ HO$.

If mono-stearine is heated with 15 to 20 times its weight of stearic acid to 270°C. for several hours:

Tetra-stearine $C^{150}H^{146}O^{16}=4(C^{36}H^{36}O^4)+C^6H^8O^6-6\ HO$ is formed.

This Berthelot considers to be identical with the stearine found in nature.

Tetra-margarine seems to be formed, if mono-margarine is heated with excess of margaric acid to 270°C., but it cannot be obtained pure.

1655 Tetra-palmatin $C^{134}H^{130}O^{16}=4\ (C^{32}H^{32}O^4)+C^6H^8O^6+6\ HO$, melting at 60°C. and solidifying at 40°C., which latter compound Berthelot considers identical with the palmatin found in nature.

"DEFENDANTS' EXHIBIT No. 9."

Kraut—Fat Industry and Glycerine.

Vienna Exposition Report (reprint of 1877), vol. 3, page 506.

The distillation of the glycerine carried out for the purpose of purifying it as patented by G. F. Wilson and G. Payne, on the 8th of February (4th of August), 1855, is therefore a marked step in the development of the manufacture of glycerine.

"DEFENDANTS' EXHIBIT No. 10."

Kraut—Fat Industry and Glycerine.

Vienna Exposition Report (reprint of 1877), vol. 3, page 506.

The idea that the decomposition of neutral fats might be effected by superheated water made its appearance at the same time with Milly's method. Tilghman and Melsens introduced this method into practice independently of each other and secured a temporary success, partly by using the apparatus constructed by Wright & Fouché. We do not know if this method is still in use anywhere.

1656 This much is certain, that the Vienna manufacturers reported to be using this plan in 1863 by Stass, two years later had adopted Milly's autoclaves.

"DEFENDANTS' EXHIBIT No. 11."

Musprat's Handbook of Technology (German Edition), 1877, vol. 4, page 455.

Purified tallow furnishes, according to Stass, 95.5 to 96 per cent. fresh palm oil, 93.5 to 94 per cent. * * * of crude fatty acids.

"DEFENDANTS' EXHIBIT No. 12."

Uses of Glycerine.

Extract from Wagner's Year Books for 1857, 1858, 1859, 1860, 1861, 1862, 1864, 1866, 1867, 1870, 1871, and 1874.

1857, p. 38. G. Arnandon describes a process for dying with madder in the cold, using glycerine.

From Technologist, January, 1858, p. 191.

1858, p. 550. Both processes (*i. e.*, that of heating fat with lime hydrate by E. Meyers, and that of Milley) of saponification have the great advantage, besides those already mentioned, of requiring very little water, and thus yielding a very concentrated solution of glycerine, which is beginning to be used as a lubricant in photography, etc., and which may be prepared at no great cost. Wagner's own comment.

1657 1858, p. 551. F. Wilson speaks about the preparation and uses of glycerine. Among other things, he finds that organic matter, especially meat, will be preserved in it.

From the Journal of Soc. of Arts.

Bainswil proposes the use of glycerine to keep modeling clay moist.

Technologist for December, 1858.

Glycerine may also be used for the preservation of foods, in candies, fruits, and chocolate in place of inclosing in tin-foil.

To prevent drying also for snuff and tobacco; it is also proposed to use glycerine in gas-meters. Glycerine might also be used as a

lubricant for machinery, and especially for watches and chronometers. Glycerine might also greatly improve copying ink.
Technologist, December No., 1858, p. 572.

1859, p 572. Glycerine has been proposed as an addition to wall-paper to make its surface absorbent.
From Genie Industriel, April, 1859, p. 176.

1859, p. 608. C. Gros Renaud, Repertoir de Chemie, Appliqué, 1859, vol. 1, p. 427, reports on new applications of glycerine (*a*) as a solvent of aniline violet for the purpose of purification, (*b*) solvent for gum arabic, (*c*) solvent for egg albumen.

Courboulay. Genie Industrial, 1859, vol. 1, p. 150, on the applicability of glycerine as a cosmetic.

1860. Sobrero. Report de Chim., Appl., vol. 2, p. 400, proposes a preparation for the manufacture of nitro-glycerine.

1861, p. 654. Santi-Comptes Reuches, vol. 51, p. 1093, uses glycerine in compasses.

1658 1862, p. 631. Elsner, Pol. Cent. Blat., 1863, p. 79, uses glycerine for leather belts to prevent cracking, and proposes to use it also for other leather manufactures.

1862, p. 691. Friedheim. Dingler's Jr., vol. 166, p. 237, uses glycerine to prevent the adhesion of mercury in glass, in the tubes of manometers.

1864, p. 676. V. Kletszinsky. Dingler's Jr., vol. 171, p. 670, mentions among new uses the use of glycerine as an extractive substance in perfumery, as a cosmetic for the preservation of the hair, for the improvement of wine, in liquor to make an extract from hops, therefore perhaps to improve lager beer.

1866, p. 297. A. Nobel. Dingler's Jr., vol. 180, p. 491, proposes the addition of methyl alcohol to nitro-glycerine to protect it from explosion accidentally.

Experiments made in a number of places and good results obtained caused nitro-glycerine to be employed in the large sandstone quarries of the Zornthal.

Page 298. K. List (Berggeist, 1866, No. 10) reports that nitro-glycerine may decompose spontaneously, but that there is no danger if the gases produced can pass off freely.

1866, p. 300. Heeren (Dingler's Jr., vol. 180, p. 481) gives a recipe for the manufacture of a fluid glycerine soap.

Page 646. C. Puscher (Dingler's Jr., vol. 181, p. 158) proposes the use of glycerine as an addition to glue to reduce the brittleness.

1867, p. 318. J. Fuchs (Dingler's Jr., vol. 184, p. 541) reports that the use of glycerine to impregnate wooden vessels is found efficient now after several years use.

1659 Page 310. Nobel (Dingler's Jr., 183, p. 221) obtained a patent in Bavaria and other countries for the use of nitro-glycerine in place of gunpowder.

Nitro-glycerine, by reason of its extraordinary properties, has met with favor in a great many places, in such a way as has happened with very few other inventions, and will, no doubt, be substituted for gunpowder generally in blasting.

1867, p. 246. C. L. Nobel (Pol. Cent. Bl. 167, p. 1429) calls attention to his patent powder, dynamite, a new blasting explosive.

Page 253. Glycerine has for some time past been frequently employed for the improvement of wine.

Page 359. Payne (Annales de Genie Cevil, 1867, p. 738) on the manufacture of transparent glycerine soap.

1870, p. 266. On account of the increased demand for glycerine in the manufacture of wine and beer, it has become desirable to possess means for a ready control of its value. Here follow specific gravity tables of A. Metz and Fabian, and the table of Fabian is the oldest, and has been published as early as 1860. Wagner's Year Book, 1860, p. 609, H. Schwerkert prepared a table in 1869. Zeitschrift puer Anal. Chem., 1869, p. 512.

Page 462. H. Fleck, Bierbrauer, 1869, No. 12, on the use of glycerine in brewing beer.

1871, p. 375. A very important improvement regarding the purification of glycerine has been invented by K. Kraut.

Deut-che Industrie zeit, 1871, p. 498, follows description of crystallization of glycerine, 309. Explosion of nitro-glycerine factories have, of late, repeatedly occurred (see Wagner's Year Book, 1870, p. 219.)

The Prussian government asks, therefore, for a report from
1660 the royal technical deputation, and advice regarding the means of preventing explosions and points of interest in regard to licensing such places.

1874, p. 495. E. Shering, director of the chemical factory, Auf. Actien, in Berlin, reports on the manufacture of glycerine. Industrie blátter, 1874, No. 227; Dingler's Journal, 213, p. 217.

Raw glycerine is a by-product of the manufacture of stearine. The dilute glycerine solutions were formerly allowed to run to waste. At present, it is doubtful whether this is done anywhere, for the article has become valuable and is much in demand.

The methods used for the decomposition of fat are—1, old-time process, using excess of lime; 2, action of a few per cent. of sulphuric acid upon the fat; glycerine thus prepared contains sulphoacid of glycerine; 3, fats are decomposed by means of superheated steam only, and the fat acids and glycerine distilled.

"DEFENDANTS' EXHIBIT No. 13."

Table of Pressures and Temperatures.

French system.				American system.	
Atmospheres.	Pounds per square inch.	Temperature, Fahrenheit.	Temperature, Centigrade.	Atmospheres.	Pounds per square inch.
1	15	212°	100°	0	
1½	22.5	233°	112°	½	7.5
2	30	250°	121°	1	15
2½	37.5	263°	128°	1½	22.5
3	45	275°	135°	2	30
3½	52.5	285°	141°	2½	37.5
4	60	293°	145°	3	45
4½	67.5	300°	149°	3½	52.5
5	75	307°	153°	4	60
5½	82.5	314°	157°	4½	67.5
6	90	320°	160°	5	75
6½	97.5	326°	163°	5½	82.5
7	105	331°	166°	6	90
7½	112.5	336°	169°	6½	97.5
8	120	341°	172°	7	105
9	135	350°	177°	8	120
10	150	358°	181°	9	135
11	165	366°	186°	10	150
12	180	374°	190°	11	165
13	195	380°	193°	12	180
14	210	386°	297°	13	195
15	225	391°	199°	14	210
20	300	418°	214°	15	225
25	375	439°	226°	20	300
30	450	457°	236°	25	375
35	525	472°	244°	30	450
40	600	486°	252°	35	525
45	675	491°	255°	40	600
50	750	510°	266°	45	675

Table of Analyses.

Analyses of products produced in digesters under pressure.

	Analyzed by Dr. Endemann.	Analyzed by Dr. Endemann and President Morton.	Analyzed by President Morton.
Made at Hoboken March 31st Water alone; no lime (water 2, fat 1) 6 hours, 90 pounds pressure	April, 1883—Without removing lead, 61.83		May, 1883—With lead removed, 68.8, 70.8, 70.3, 68.8.
Made at Hoboken March 30th Water and lime (water 2, fat 1), lime 1 p. c. 6 hours; 90 pounds pressure	April, 1883—With partial removal of lime and lead, 84.18		May, 1883—With entire removal of lime and lead, 90.6, 92.0.
Made at Cincinnati May 10th Water alone 9 hours; 131 pounds pressure		May 12th—No lead or lime present, 76.47.	
Made at Cincinnati May 10th Water and lime 9 hours; 131 pounds pressure	May 12th and 14th—With entire removal of lime, 88.07	May 12th—With entire removal of lime, 88.85.	
Made by Mr. Gamble April 19th Water alone 14 hours; 150 pounds	April 28th (about)—No lime present, 88.81		No lime present. May 8th—90.1, 90.6. June 11th—92.46.
Made by Mr. Gamble April 13th With water and lime 8½ hours; 150 pounds	April 28th (about)—97.5		June 1st—94.3, 94.4, 94.9
Made at Cincinnati May 10th and 11th With water alone 18 hours; 131 pounds		May 12th—With entire removal of lime, 84.43	

"DEFENDANTS' EXHIBIT No. 15."

Table of Analyses at 225 Pounds.

	A No. 1.	B No. 2.	C No. 3.	D No. 4.	E No. 5.	F No. 6.	G No. 7.
A	*2.7	*2.7	*2.7	*3.6	*2.9		
B	*6.1			*65.1[2]		7.8	
C	*8.9			*82.0		22.2	
D	*20	56	51.2	*91.4	*93.0	55.3	
E	*43.0	*75[2]	71.9	*92.7	*94.7[2]	73.5	
F	*65.8	82.5	82.1	*92.3	*93.9	87.0	
G	*80.1	89.6	87.9	*92.4	*95.4	92.3	
H	*86.7	*90.5[2]	*90.4[2]	*92.3[2]	*95.8	93.5	92.0
I	*90.0	*91.6[2]	*91.5	*90.7[2]	*94.2	93.5	*94.5[2]
J	*90.9	*91.7	*92.3	*92.7	*96.7	*95 0	*94.7[2]
K		*91.5	*96.3	*97.7	*99.3	*99.1	*98.6
	80 per cent. aq. No line. No change of water.	50 per cent. aq. No line. No change of water.	50 per cent. aq. No line. 50 per cent. aq. at 8½ hours.	50 per cent. aq. 1 per cent. line. 50 per cent. aq. at 8½ hours.	100 per cent. aq. 1 per cent. line. 100 per cent. aq. at 8½ hours.	100 per cent. aq. No line. 100 per cent. aq. at 8½ hours.	100 per cent. aq. 10 per cent. fat acid. 100 per cent. aq. at 8½ hours.

Horizontal line shows where change of water occurred.
The star before the figure denotes that the sample was treated with sulphuric acid to remove any base.

"DEFENDANTS' EXHIBIT No. 16."

Table of Glycerine Water Densities at 225 Pounds.

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 7.
P		1000	1000	1020	1005	1000	1000
Q		1000	1000	1037	1020	1000	1004
S		1010	1005	1043	1027	1007	1013
T		1024	1025	1043	1027	1013	1021
U		1032	1030	1042	1026	1023	1024
V		1034	1035	1041	1026	1024	1016
W		1035	1040	1040	1027	1025	1026
X		1037	1040	1038	1026	1025	1025
Y		1035	1040	1037	1025	1028	1025
Z			1007	1013	1003	1000	1004

1664 "DEFENDANTS' EXHIBIT No. 17."

Gamble Letters.

Letters received from Mr. Gamble, with specimens of fat acids and lime soaps.

First letter. Dated April 12th, 1883.

Prof. Morton, Stevens Institute.

SIR: We forward to you by express to-day a sample of the product from our digester, saponified with 1 per cent of lime at a pressure of 150 pounds, which pressure was maintained during 11½ hours. We will, at request of Mr. Parkinson, early next week, forward a sample of product by use of water alone, and also by running our usual time of about 9 hours with 1 per cent. lime.

Respectfully, PROCTER & GAMBLE.

Second letter. Dated April 17th, 1883.

Prof. Morton:

We send herewith sample lime soap and fat acid produced by our ordinary method of saponification in autoclave or digester, in which materials were exposed for 8½ hours at 150 pounds pressure. We will forward in a day or two sample of result of "running" with water alone.

Respectfully, PROCTER & GAMBLE.

Third letter. Dated April 20th, 1883.

Prof. Morton.

SIR: We send herewith sample marked C, April 19th, 1883, which is of tallow digested in our digester with usual quantity of
1665 water, but without lime. The operation was begun at 5.30 a. m., and continued until 5 p. m., when the first charge water was blown off, the second added, and operation continued until 8 p. m., at which time the second water and fat acids were blown out.

Glycerine marked as follows:

At	1	p. m.	7½	hours	2½° B.
"	2	"	8½	"	3° "
"	3	"	9½	"	3½° "
"	4	"	10½	"	3¾° "
"	5	"	11½	"	3¾° "
"	8	"	second water		½° "

Respectfully, PROCTER & GAMBLE.

Samples received with the above letters were marked:

With first letter, A, April 12th, 1883.

As this did not represent anything we wished to know it was not analyzed, and no reference was made to it in the testimony.

With the second letter, B, April 13th, 1883.

This is the sample analyzed by Dr. Endemann with the result 97.5, and by me with the results 94.3, 94.4, 94.9.

With the third letter, C, April 19th, 1883.

This was analyzed by Dr. Endemann with the result 88.81, as he reported it to me, and by me soon after with the results 90.1 and 90.6, and after my return from Cincinnati with the result 92.46.

1666 "DEFENDANT'S EXHIBIT No. 18."

Booth's Encyclopedia.

Extract from the Encyclopedia of Chemistry, by James C. Booth, Philadelphia, 1850, p. 889.

Bistearate of potassa, KO,ST+HO. Crystallizes in pearly scales from an alcoholic solution. It is insoluble in cold water, but, by boiling 1 pt. with 1,000 of water, an insoluble quadri-stearate, $C_{68}H_{66}O_5$,2KO+3($C_{68}H_{66}O_5$2HO), is formed. The filtered liquor then drops, upon cooling and repose, bistearate of potassa, while it retains in solution an alkaline stearate.

The corresponding soda salts are very analogous, though less soluble in water and less easily decomposed.

"DEFENDANT'S EXHIBIT No. 19."

Hausamann Article.

Dingler's Polytechnic Journal, 1881, vol. 240, p. 62.

(The determination of undecomposed fat in mixtures used for the preparation of fatty acids. By Dr. Oskar Hausamann.)

The incomplete decomposition of the neutral fats in the manufacture of stearine results in defective working of the mixtures used, a reduced yield of stearine, and an increased cost. An accurate knowledge of the products of saponification of the neutral fats and of their percentage of undecomposed fat is therefore important, not only
1667 in controlling the separate operations, but also in determining the method of decomposition itself.

The methods in use hitherto for the determination of the neutral fats in these mixtures are, so far as is known, that proposed by Nitsche (1876, 220, 459) and the older determination of the glycerine in the neutral fat present. Nitsche's method is based upon the insolubility or difficult solubility of neutral fats in alcohol. As the neutral fats are soluble in alcohol containing fatty acid only enough alcohol is used to produce a 2 per cent. solution. Neutral fats are not at all insoluble, however, in pure alcohol; therefore a good deal of neutral fat will not separate, owing to the proportionally large quantity used, and will consequently escape weighing. Besides this very serious source of error, this method has the disadvantage of requiring a good deal of time. The other method of weighing the glycerine of the neutral fat present is somewhat more accurate, but

it takes much time and can be performed only with large quantities—at least 100 grammes. It is therefore still less suitable for manufacturing purposes than the process proposed by Nitsche.

We may attain our object much more surely and speedily by determining volumetrically the fatty acid present in the mixture. If we drop alkali into an alcoholic solution of fatty acid and neutral fat only the free fatty acid enters into combination, and the neutral fat remains unchanged. If, however, we add an excess of alkali at once the neutral fat is decomposed and becomes saponified together with the fatty acid. Hence the amount of fatty acid is measured by neutralizing the mixture in question with an alkaline solution of certain strength. As is well known, the fatty acids concerned in the manufacture of stearine are a mixture of three, or at least of two,
different acids. If, therefore, the proportions of the mixture
1668 are not known, the results of the volumetric analysis cannot be computed. These proportions are determined by first subjecting the mixture to be analyzed to complete saponification.

5 grammes of the mixture are dissolved in a little alcohol, and 1 or 2 drops of an alcoholic solution of phenolphtalein are added. Then we add the normal alcoholic solution of alkali until a red color makes its appearance, or we add a little excess and then neutralize back with normal oxalic acid until the last red tint disappears. Let the number of cubic centimeters of normal alkali be 17, for example; then the mixture contains an amount of free fatty acid corresponding to 17 c. c. of normal alkali.

Now warm 5 g. of the substance with 25 c. c. of an alcoholic solution of normal alkali in a water bath until it is completely dissolved. The alkali in excess saponifies the neutral fat at the same time as the fatty acid. Then neutralize with standard oxalic acid. If, for example, it took 6.7 c. c. of oxalic acid, then 18.3 c. c. of normal alkali sufficed to neutralize both the fatty acid and the neutral fat.

If the mixture analysed was, for example, a sample taken from a digester (autoclave), and consisted of stearic, palmitic, and oleic acids, whose molecular weights are 284, 256, and 282, we have the relation, 18.3 c. c. of normal alkali correspond to 5 g. of the mixture, therefore 1000 c. c. normal alkali $= (5000 \div 18.3) = 273.2$ g., or 273.2 g. of the mixture answer to 1 liter of normal alkali; therefore 273.2 is the molecular weight of the mixture. Again, 5 g. of the mixture require 17 c. c. normal alkali; therefore they contain $17 \times .2732$ g. $= 4.644$ g. of fatty acid. 100 g. therefore contain 92.8 per cent., and the sample contains 7.2 per cent. of neutral fat.

If samples of the same operation in its different stages are to be analyzed, the second titration for determining the molecular weight
need be made only once, as the proportions of the fatty acids
1669 remain constant, and there is no reason for supposing that the decomposition of the neutral fats does not affect all three uniformly. This determination is to be made, of course, only at the close of the operation, when the amount of neutral fat present is at a minimum, because, with larger quantities of undecomposed fat, the glycerine, which is weighed with the sample, might influence the accuracy of the result. In that case, and in general, when we have to do with a mixture which probably contains much neutral fat, it is

well to treat a sample whose molecular weight is to be determined differently from the above method; it should first be completely saponified, and then the separated fatty acids should be determined volumetrically.

The best way to do this is as follows: Heat about 50 g. of the mixture until it begins to give off vapors, and add, with constant stirring, a mixture of about 25 c. c. 95 per cent. alcohol, 40 c. c. concentrated lye, and 25 c. c. water. The saponification is instantaneous. Boil with 1 liter of distilled water for about an hour until all the alcohol is driven off. This must be carefully observed or else the corresponding ether will inevitably be formed on precipitating the fatty acids with sulphuric acid. The precipitated fatty acids are washed, melted together, and freed entirely from moisture by heating cautiously. If mechanical impurities should be present, the fatty acids may be passed through a paper filter without using a funnel. Weigh off 5 g. from this substance, which is free from neutral fat, and find the mean molecular weight by means of the standard solution of alkali.

With samples of fatty acids which contain but little neutral fat the first method may be used without producing any serious errors. It is advantageous in all cases not to use the standard solution full strength, but to dilute to one-half or even less, because, as is easily seen, we have to deal with large numbers.

1670 The applications of this method are numerous. In order to study the process of decomposition in the autoclave, for example, the quantity of fatty acids present may be ascertained volumetrically from time to time; a second analysis would then determine the amount of fatty acid still combined with lime. For this purpose the sample is first decomposed with sulphuric acid. The molecular weight is determined at the end of the operation. Moreover, the amount of neutral fat contained in all mixtures from that used in the autoclave to commercial oleine may be determined expeditiously and accurately.

When only two fatty acids are present, as for example in stearine, their proportions also are found by titration. A sample of stearine which requires 18.2 c. c. of normal potassa for 5 g. has a molecular weight of 274.7; this corresponds to the proportion of about 67 parts of stearic and 33 parts of palmitic acid, as is shown by the following table:

Palmitic Acid.		Stearic Acid.		Mean Molecular Weight.	
100 p.c.	256.0	— p.c.	—	256.0	
90 "	230.4	10 "	28.4	258.8	
80 "	204.8	20 "	56.8	261.6	
70 "	179.2	30 "	85.2	264.4	Difference 2.8.
60 "	153.6	40 "	113.6	267.2	
50 "	128.0	50 "	142.0	270.0	
40 "	102.4	60 "	170.4	272.8	
30 "	76.8	70 "	198.8	275.6	
20 "	51.2	80 "	247.2	278.4	
10 "	25.6	90 "	255.6	281.2	
— "	—	100 "	284.0	284.0	

If a sample of stearine is mixed with paraffine, the amount of the latter is determined rapidly and certainly by the method described, by determining simply the fatty acid. Of course the molecular weight cannot be found in this case without separating the
1671 paraffine; as, however, a large number of experiments have shown that stearine from tallow, whether obtained by pressure or by distillation, has a molecular weight of 273.2, we may use this number in the computation. Stearine from other sources may yield a different average.

We may add to this that stearine obtained by distillation has always been found free from neutral fat, even when the original substance contained the latter in a considerable quantity. This indicates that neutral fats, at least in the presence of free fatty acids, cannot be distilled; as, however, neither the losses nor the formation of acroleine are abnormal in such substances it may be assumed that the high temperature of distillation combined with the steam acts similarly to the autoclave.

It is evident, finally, that this method is suitable also for the determination of unsaponified fat in soaps; its use may indeed be extended in various directions, and any one with some experience will be able to adapt it to the prevailing conditions.

Milly Candle Factory, Liesing, near Vienna.

"DEFENDANTS' EXHIBIT No. 20."

Groger Article No. 1.

Dingler's Polytechnic Journal, 1882, vol. 244, p. 303.

(The Determination of Neutral Fat in Mixtures used for the Preparation of Fatty Acids. By Max Gröger.)

1672 (From the technological laboratory of Prof. K. Zulkowsky in the Technical High School at Brünn.)

O. Hausamann (1880, 240, 62)* published a process for determining the undecomposed fat in the manufacture of fatty acids, in the application of which I obtained no satisfactory results, and this induced me to test the method, especially as Hausamann published no analyses made by it. It turned out, however, that the method is a very excellent one, and that my failures were due only to the inaccurate description of it.

In the experiments to be described I used fresh, melted, and filtered beef tallow, which was then entirely freed from water—also the mixture of fatty acids obtained by saponifying this tallow with pure caustic potassa, treating the resulting soap with dilute sulphuric acid, washing and drying the precipitate.

Hausamann states that if an alcoholic solution of potassa is added, drop by drop, to an alcoholic solution of a mixture of free fatty acids and neutral fat only the former are saponified, and the latter remains unchanged. To convince myself of the correctness of this statement, I dissolved neutral beef tallow in boiling alcohol, added

*This reference is wrong. It should be 1881, 240, 62. (Translator.)

a few drops of an alcoholic solution of phenolphtalein and 0.1 c. c. of a standard alcoholic solution of potassa reduced to half its strength. It became red immediately, and the color remained for about five minutes even at boiling heat, but disappeared entirely after ten minutes, which shows that the saponification is really extremely slow in presence of an excess of neutral fat. Free fatty acids dissolved in alcohol, on the contrary, are instantly saponified.

I first determined the equivalent (Hausamann speaks of a mean molecular weight) of the mixture of fatty acids dissolved in
1673 hot alcohol by adding an alcoholic solution of potassa of known strength; it was 271. In the next place, I prepared different mixtures by melting together weighed quantities of neutral fat and fatty acids, and determined the former according to Hausamann's directions. He says: Dissolve 5 g. of the substance in a little alcohol, add 1 or 2 drops of a solution of phenolphtalein and titrate with an alcoholic standard solution of alkali until the red color appears; but he does not state whether to dissolve and titrate cold or warm. At the ordinary temperature the titration cannot be performed without using a very large quantity of alcohol, both to make the neutral fat dissolve and to prevent the separation of little lumps of soap when the potassa lye is added, which inclose a large portion of the solution and protect it from the action of the potassa. If, however, we operate at a temperature near the boiling point of alcohol, 25 to 30 c. c. of alcohol will suffice for completely dissolving 5 g. of the mixture of fatty acids and also the resulting soap.

The number of cubic centimeters of standard alkali used multiplied by the thousandth part of the equivalent of the mixture of fatty acids will give the amount of free fatty acids, and this number subtracted from the weight of the substance will give the weight of the neutral fat contained in it.

The equivalent, *i. e.* the weight, of the mixture of fatty acids which is saponified by 1 liter of standard alkali is determined by Hausamann in two ways—

(A) When a large quantity of neutral fat is present he saponifies completely by means of an excess of alkali, separates the free fatty acids, and titrates a weighed quantity of these with an alcoholic solution of potassa.

(B) When a small quantity of neutral fat is present he heats the mixture containing it with an excess of an alcoholic solution of potassa "to complete solution," and then neutralizes back with standard oxalic acid.

1674 In this way we find out how many cubic centimeters of normal alkali are necessary to saponify perfectly a given mixture. If p grammes are saponified with n cubic centimeters of normal potassa, and neutralized again with m cubic centimeters of normal oxalic acid, and if we neglect the small quantity of glycerine contained in the substance, the equivalent A is obtained from the proportion $p : A\ (n—m) : 1{,}000$ as very approximately $A = \frac{1{,}000\ p.}{n—m}$

Now, upon investigating the mixtures alluded to above I obtained

the following results: Column I of the following table contains the real percentage of neutral fat; column II, the percentage calculated on the basis of the equivalent 271 of the separated free fatty acid; column III, the percentage calculated by using the equivalent determined according to (B):

I.	II.	III.
13.15	13.40	5.50
5.02	4.84	3.21
12.58	12.81	10.72
6.94	6.96	2.78
3.12	3.30	2.71
0.73	0.61	0.61

The numbers in columns I and II agree very well, but those in III are wide of the mark and almost all too low. I thought at first that I could explain these discrepancies by the supposition that the beef tallow used was not composed only of triglycerides, and tried to determine the percentage of the fatty acids contained in it. I heated it with an excess of alcoholic potassa until it was completely dissolved, and then neutralized again with oxalic acid. The number of cubic centimeters of potassa used with the thousandth part of the previously found equivalent, 271, gives the amount of fatty acids contained in the weight of beef tallow used. We may consider that in the triglycerides 3 equivalents of the fatty acids 1675 (or, in the present case, $(3\times271=813)$ are combined with 1 equivalent of the glycerine residue $(C_3H_2=38)$—$C_3H_5(O\,C_nH_{2n-1}O)_3=C_3H_2+3\,C_nH_{2n}O_2$—which answers to 95.65 per cent. of fatty acids. I found, however, in several analyses, the numbers 90.3, 89.4, 73, 82.1, and 88.2.

Now, as each of these carefully performed analyses gave a different figure for the amount of fatty acids contained in neutral fat, and as it was entirely impossible for the tallow used to vary in composition, I had to look for a different explanation of these anomalies, and I found it at last in the different duration of the process of saponification. The saponification of neutral fats by treating with an excess of alcoholic potassa diluted to such an extent (about half the standard strength) is by no means so rapid as is generally believed, and heating "until perfectly dissolved" is not at all sufficient.

In order to demonstrate this beef tallow was warmed with an excess of alcoholic potassa until completely dissolved, and the excess of caustic potassa was immediately neutralized with oxalic acid. From the known equivalent of the fatty acids the quantity saponified by the caustic potassa was found for the substance used to be 47.9 per cent.; as this neutral fat really contained 95.65 per cent., it follows that only $100 \times (47.9 : 96.65) = 50$ per cent. had been saponified. In a second experiment the substance was heated for ten minutes after complete solution and then titrated. The potassa combined this time with 94 per cent. of fatty acid and therefore saponified only 98.2 per cent. of the neutral fat. On diluting with water the solutions obtained in these experiments, and which were perfectly clear when hot, the neutral fat separated in little drops.

In the third analysis the heat was continued for 20 and in the fourth for 30 minutes after the substance was completely dissolved and the caustic potassa combined with 95.7 and 95.6 (the
1676 theoretical quantity) of fatty acids; hence the whole of the neutral fat had been saponified.

Kottstorfer (compare 1879, 232, 286) had the same experience in his examination of butter. He found that heating with alcoholic potassa for five minutes was not sufficient for complete saponification.

Later experiments, in which saponification was effected by boiling for half an hour with an excess of alcoholic potassa, gave good results in determining the neutral fat in mixtures of fatty acids where the equivalent determined according to (B) was used, as the following figures show:

Percentage of Neutral Fat.

Real.	Found.
11.80	11.50
5.17	4.67
3.40	3.21
1.25	1.05

The following method is therefore recommended: Dissolve 3 to 5 g. of the previously dried mixture of fatty acids whose percentage of neutral fat is required by heating in a flask having a capacity of 150 c. c. in about 25 to 30 c. c. alcohol of about 96 per cent. Tr. Add 1 or 2 drops of an alcoholic solution of phenolphtalein, and determine the free fatty acids by titrating with alcoholic potassa (of about one-half the standard strength) until the red coloration no longer disappears immediately on shaking. (If any soap should separate on adding the potassa, the liquid must be heated again to dissolve it). Then, in order to determine approximately the equivalent of the fatty acids, a measured quantity of alcoholic potassa in excess is added. Close the flask with a cork containing a glass tube 80 c. m. long, which acts as a condenser of the vapor, and maintain at a gentle boiling heat for 30 minutes, during which the red color must not disappear; if it should do so, more potassa must be added.

Then neutralize again with normal oxalic acid of half
1677 strength (neglecting the precipitate of potassium oxalate which is formed) until the red color disappears.

This method gives accurate results only when the neutral fat to be determined is the same as that from which the free fatty acids had been separated, and only then under the supposition that all components of the fat participate equally in the saponification. The method as extended by me enables us to determine accurately any given neutral fat to which any free fatty acids have been added. This is frequently important, as, for example, when we wish to find the amount of tallow that has been added to stearine candles to make them cheaper, or the amount of cocoanut oil found in the so-called composite candles, etc.

If to the heated alcoholic solution of the substance in question,

containing a few drops of phenolphtalein, alcoholic potassa is added, drop by drop, until it turns red, all free fatty acids are converted into potassa soaps, and the neutral fat is left unchanged. The next step is to separate them. If we dilute the solution with water, the neutral fat separates in drops, while the soap remains in solution. As, however, the neutral fat forms an emulsion with the solution of soap, they cannot be separated by filtration or by letting them stand. But the soap solution may be completely freed from neutral fat by shaking with ether. I proceed, therefore, as follows:

4 to 8 g. of the substance to be tested for neutral fat (according as there is more or less of it present) are dissolved by gently heating to the boiling point in 50 c. c. alcohol of about 96 per cent. Tr. in a flask holding about 300 c. c. A few drops of a solution of phenolphtalein are added, and alcoholic potassa of half the standard strength is allowed to flow from a burette until the red coloration no longer disappears immediately on shaking; then dilute with 150 c. c. of water. This reduces the alcohol to 20 to 25 per cent.
1678 Tr., in which the neutral fats are as good as insoluble, while the potassa soaps still form a perfectly clear solution. When cold add 60 to 100 c. c. of ether, cork the flask, shake thoroughly, and let stand until the soap solution under the layer of ether has become perfectly clear. Now pipette off carefully the greater part of the clear soap solution, so as to carry over none of the ether, dilute greatly with water, and boil until the ether and the alcohol are entirely driven off. Then liberate the fatty acids with dilute sulphuric or hydrochloric acid; after they have perfectly separated as an oily layer wash them with hot water until the latter no longer gives an acid reaction, and allow it to cool. If the fatty acids form a cake lift it off without paying any attention to any portions that may adhere to the sides of the vessel; if they remain liquid pipette off the greater part. Dry carefully and determine the equivalent by titrating with alcoholic potassa of half the normal strength in the way described above. The number of cubic centimeters of normal alkali used up to neutralize the free fatty acids in the mixture containing the neutral fat, multiplied with the thousandth part of the equivalent thus found, gives the weight of the fatty acids contained in it, and consequently also the amount of neutral fat mixed with them.

The ethereal solution of the neutral fat may be used to determine the nature of the fat after evaporating the ether.

I convinced myself in the following way that at the ordinary temperature the 25 per cent. alcohol, saturated with ether, which was under the layer of ether, dissolves a very insignificant amount of neutral fat. In one experiment I dissolved 1 g. of beef tallow and in another 2 g. of beef fat in boiling alcohol of 98 per cent. Tr., diluted with 3 times the volume of water and shook with ether. When it was clear 100 c. c. of the layer under the ether, in both cases, left a residue of not quite 1 mg. on evaporation, a quantity to which
1679 we shall pay no attention here. For mixtures made with commercial stearic acid, whose equivalent was found to be 264.4, and with the above beef tallow, I found the following numbers by this method:

Percentage of Neutral Fat.

Really present.	Found.
8.50	8.19
22.62	22.84
41.19	41.19

In these mixtures approximately correct numbers would have been obtained, even if they had been completely saponified, and if the equivalent of the separated fatty acids had been determined, because the equivalents 264.4 and 2.71 do not differ much. For this reason I made some mixtures of the fatty acids of beef tallow and beef fat, which latter I prepared by melting, filtering, and carefully drying fresh butter. As the equivalent of the fatty acids of butter is the lowest among fats, and differs considerably from that of the fatty acids in other animal and vegetable fats, a determination of the equivalent made by complete saponification of the mixture and separation of the free fatty acids will give very erroneous values for the percentage of neutral fat, and the error will be the greater the more neutral fat is present. For this reason I consider these mixtures especially suitable for testing the accuracy of my method.

The beef fat is much more easily saponified than beef tallow. The red color produced by 0.1 c. c. of potassa of half the standard strength in a boiling hot solution of beef fat in alcohol, to which phenolphtalein has been added, disappears completely in 1 minute, while with beef tallow it lasts almost 10 minutes; it lasts long enough, however,
to enable us to determine with precision any fatty acids mixed
1680 with it, which cause the red coloration to disappear immediately.

With mixtures of beef fat and of fatty acids (equivalent 271), which were obtained from beef tallow, the following results were had:

Percentage of Neutral Fat.

Really present.	Found.
9.9	9.5
20.1	20.6
41.7	41.1
60.5	60.1

By means of this method we could also discover whether all the components of a given fat participate equally in an imperfect saponification; whether, *e. g.*, in the contents of an autoclave, to which Hausamann applies his determinations of neutral fat, the still unsaponified fat and the proportion of the different liberated fatty acids are the same at all stages of the process of saponification. For this purpose the free acids are titrated with alcoholic potassa until the red coloration is permanent, the soap formed is freed from neutral fat with ether, as described above, the fatty acids are separated, and their equivalent is determined volumetrically. If the equivalent is constant within allowable limits of error the correctness of the above supposition is demonstrated. If the values obtained vary (which must be according to some law) the supposition is incorrect.

In like manner we could use for this demonstration the neutral fat obtained on evaporating the ethereal solution by determining, according to Köttstorfer (1879, 232, 286), the amount of hydrate of potassium which 1 g. of the neutral fat requires for complete saponification. I regret that I have not yet had an opportunity to apply this process to the contents of an autoclave.

1681 The use of the alcoholic solution of potassa has the disadvantage that its strength varies considerably on keeping. That of the solution used in the above experiments was tested every other day with oxalic acid of half the normal strength and gave the following values:

Normal.	Normal.
0.3839	0.3740
0.3800	0.3695
0.3783	0.3682
0.3741	0.3660

In two weeks it had, therefore, lost 4.6 per cent. of its original strength. For accurate determinations the strength must not be considered invariable except for 1 or, at most, for 2 days. When the strength is approximately known it is very little trouble to determine it anew. It takes only ten minutes and requires 20 to 30 c. c. of the alcoholic solution of potassa.

The strength of the alcoholic potassa solution diminishes also somewhat on boiling for half an hour, but the change is so slight that it may be neglected entirely.

The deep yellow color which the alcoholic solution of potassa assumes after a short time is another disadvantage, because it renders it difficult to recognize the final reaction, the appearance or disappearance of the red coloration. This may be overcome by shaking the alcoholic solution of potassa with fresh, finely-pulverized spodium and filtering, which almost entirely decolorizes it. The strength diminishes, however, at the same time, because the spodium absorbs not only the coloring matter, but also some caustic potassa. If the solution is kept in a bottle, the bottom of which is covered with coarsely-powdered spodium freed from dust by passing through a sieve, it retains a very pale yellow color for a long time and appears almost colorless in the burette.

Brünn, beginning of March, 1882.

1682 "DEFENDANTS' EXHIBIT No. 21."

Groger Article No. 2.

Dingler's Polytechnic Journal, 1882, vol. 246, page 286.

The Determination of Neutral Fat. By Max Gröger.

(Chemical laboratory of the Imperial Technical School at Brünn.)

The volumetric method for determining neutral fat in fatty acid mixtures (cf. 1882, 244, 303) may be greatly simplified under the supposition that the proportion of the different fatty acids in the

neutral fat before saponification is the same as in the mixture of fatty acids produced by saponifying the contents of the autoclave.

If the quantity of neutral fat present does not exceed the limit at which it is safe to neglect the residue of glycerine, it is only necessary to know the ratio of the free fatty acids to those still combined with glycerine in order to calculate the percentage of neutral fat. This ratio is very easily ascertained by determining the volume of alcoholic solution of potassa necessary to saturate the free acids and the volume necessary to saponify the whole mixture.

Suppose it took a volumes of alcoholic potassa to saturate the free fatty acids, and b volumes to saponify completely, then $b-a$ volumes were needed to saponify the neutral fat, and the percentage of neutral fat is found from the proportion $100 : p = b : b-a$, and $p = 100\,(b-a) : b$.

1683 If the percentage of neutral fat is so great that we cannot neglect the glycerine residue, the same method may still be used, but we must add a correction to the formula for p.

In the above calculation a is the measure for the free fatty acids and $b-a$ the measure for the fatty acids combined with glycerine. If now it is known what neutral fat is present in the mixture, we can determine once for all (cf. 1882, 244, 305) how much free fatty acid may be obtained from 100 parts of this neutral fat. If, for instance, 100 parts of neutral fat contains P parts of free acids combined with glycerine (C_3H_2), 1 part of free acid corresponds to (100 : P) parts of neutral fat; then $(b-a)\,(100 : P)$ is the measure for the neutral fat, and $a+(b-a)\,(100 : P)$ the measure for free acid + neutral fat; hence we have the proportion $100 : p_1 = [a+(b-a)\,(100 : P)] : [(b-a)\,(100 : P)]$, whence the percentage of the neutral fat is $p_1 = [100(b-a)\,(100 : P)] : [a+(b-a)\,(100 : P)]$.

In the neutral fats used in the manufacture of candles we may consider that on an average 95.6 per cent. of free fatty acids are combined with the glycerine residue C_3H_2; then as $100 : 95.6 = 1.046$, the formula becomes $p_1 = 100[1.046(b-a)] : [(a+1.046(b-a)]$.

If very great accuracy is not required, this correction may be omitted even when there is a high percentage of neutral fat, for the values of p and p_1 differ but little from each other, as may be seen from the following table:

	b	a	p	p_1	p_1-p
	100	100	0	0.00	0.00
	100	90	10	10.41	0.41
	100	80	20	20.72	0.72
	100	70	30	30.95	0.95
	100	60	40	41.08	1.08
	100	50	50	51.12	1.12
1684	100	40	60	61.07	1.07
	100	30	70	70.93	0.93
	100	20	80	80.70	0.70
	100	10	90	90.39	0.39
	100	0	100	100.00	0.00

If a long series of analyses are to be made with the same neutral fat it is easy to calculate such a table, which will give the correct percentage p_1 of neutral fat for the ratio b : a.

It is obvious that in this process we do not need to know the strength of the potassa solution nor the weight of the sample taken to be analyzed, which is certainly a great advantage.

For the analysis we prepare a solution of about 60 g. caustic potassa in 1 liter of alcohol, of at least 96 per cent. Tr., and dilute sulphuric acid, consisting of 50 g. concentrated acid in water enough to make 1 liter. Instead of the latter, hydrochloric acid of nearly normal strength may be used to advantage. The strength of the potassa solution and of the acid need not be determined. It is only necessary to find out how many cubic centimeters of the potassa are necessary to neutralize 1 c. c. of the acid. For this purpose phenolphtalein is used as an indicator. Let us suppose it took *S* cubic centimeters of potassa.

Now dissolve 6 to 8 g. of the fatty acid mixture to be tested for neutral fat (which need not be weighed) in 50 to 60 c. c. of strong alcohol, using a flask holding about 200 c. c., and heat till perfectly dissolved. Add a few drops of an alcoholic solution of phenolphtalein, and allow the alcoholic potassa to flow in from a burette until the red color no longer disappears at once on shaking. Let the number of c. c. potassa be *a*. Now add a measured quantity (*n* cubic centimeters) of potassa solution in excess, close the flask with a cork containing a long glass tube, which acts as a condenser, and
1685 boil gently for 30 minutes. If the red color should disappear during this time add more potassa. Then neutralize back again with the acid until the red color disappears. Suppose this took *m* cubic centimeters, to which $m \times s$ cubic centimeters of potassa solution correspond. Subtracting this from the excess *n*, we obtain the number cubic centimeters of potassa solution which were needed to saponify the neutral fat, namely, $b - a = n - ms$. The percentage of neutral fat is then calculated according to the formula given above. The results of this method are very accurate, as may be seen in the following analyses, made with artificial mixtures of beef tallow and the fatty acids that had been separated from it:

Percentage of Neutral Fat.

Used.		Computed for.	Computed for.	Real.
b	a	p	p_1	
30.7 c. c.	30.0 c. c.	2.27	2.38	2.50
31.2	21.6	16.34	16.97	17.00
29.5	20.1	31.86	32.84	32.76
32.0	15.3	52.19	53.32	53.59
31.6	10.2	67.72	68.69	68.89
28.5	6.8	76.14	76.95	76.50
32.9	4.3	86.73	87.23	87.00

The whole method, as has been stated, is based on the supposition that all glycerides are equally affected in the saponification of a fat—that is to say, their ratio remains the same at the different

stages of the process. I shall shortly report upon the question whether this supposition is rigorously correct, and how the former method described by me for determining any kind of neutral fat in fatty acid mixtures may be considerably simplified.

Brünn, October, 1882.

1686 "DEFENDANTS' EXHIBIT No. 22."

Zulkowski Article.

Berichte der Deutschen Chemischen Gesellschaft, 1883, p. 1140.

Contribution to the Analysis of Fats. By Karl Zulkowski.

(Received May 3rd; read at the session by Mr. A. Pinner.)

Some time ago Mr. Max Gröger (Dingler's Polyt. Jour., 1882, 244, 303; 1882, 246, 286) made a thorough study in my laboratory of Hausamann's volumetric method for analyzing mixtures of neutral fats and fatty acids (Dingler, 1880, 240, 62). He succeeded improving and simplifying this method to such an extent that it is easier now to analyze the above mixture than a mixture of caustic soda and sodium carbonate. This method is based upon the fact that an alcoholic solution of a fatty acid is instantly saponified on adding an alcoholic solution of potassa, while neutral fats are saponified only by prolonged boiling. If, therefore, we dissolve the fatty acids and neutral fat in alcohol, add phenolphtalein and titrate with caustic potassa, the red color disappears immediately, as long as any free fatty acids are present. When these are saturated (neutralized) the liquid turns red. If now an excess of the caustic potassa solution is added and the liquid is boiled for half an hour the neutral fat is saponified. Then, if we neutralize again we obtain the volume of the potassa solution that it took to saponify the
1687 neutral fat. From the amount of this solution used to saponify the fatty acids and the neutral fats, we calculate their percentages, and it is not necessary to know the weight of the fatty mixture. These are the principles of this simple and elegant method, which furnishes very accurate results, as the experiments made with it show.

Upon carefully considering the conditions of the process, I have have found that Hausamann has struck a rich mine, which is likely to furnish much that is fine and useful in the technology of the fats. In what follows I will describe several cases in which his idea can give us extremely important information in the analysis of fats.

Berichte der Deutschen Chemischen Gesellschaft, 1883, p. 1315.

Contribution to the Analysis of Fats. By Karl Zulkowsky.

(Continuation received May 29th.)

In the 8th number of these reports I have shown in a few examples that Hausamann's method of titrating fats is applicable in many directions.

If, besides the improvements made in this province by Gröger, we avail ourselves also of the latest studies in fat analysis by Yssel de Schepper and Geitel (Dingler's Polyt. Journal, vol. 245, p. 295), almost any question that may arise in the determination of fats may be decided in the simplest manner.

In what follows I will show again, by means of a few examples, what applications may be made of this method of vulumetric analysis.

1688 JULY 31ST, 1883.

"DEFENDANTS' EXHIBIT NO. 23."

Cooley Article.

From Cooley's Cyclopedia of Practical Receipts. Sixth ed., 1880, pages 1556 to 1558.

[Stearic acid, $HC_{18}H_{35}O_2$. Syn., stearine (commercial).]

This is obtained from stearine (see below) by saponification.

Prep. 1. Repeatedly dissolve and crystallize commercial stearic acid in hot alcohol until its melting point becomes constant at not less than 158° Fahr. Pure.

2. (Chevreul.) Saponify mutton suet with caustic potassa, and dissolve the newly-formed soap in 6 times its weight of hot water; to the solution add 40 or 50 parts of cold water and set the mixture aside in a temperature of about 52° Fahr.; after a time separate the pearly matter (stearate and margarate of potassa) which falls, drain and wash it on a filter, and dissolve it in 24 parts of hot alcohol of sp. gr. 820; collect the stearate of potassa which falls as the liquid cools, recrystallize it in alcohol, and decompose it in boiling water with hydrochloric acid; lastly, wash the disengaged stearic acid in hot water and dry it.

3. (Commercial.) Ordinary tallow is boiled in large wooden vessels by means of high pressure steam, with about 16 p. c. of hydrate of lime (equiv. to 11 p. c. of pure lime), for 3 or 4 hours, or until the combination is complete and an earthy soap is formed, when the whole is allowed to cool; the product (stearate of
1689 lime) is then transferred to another wooden vessel and decomposed by adding to it 4 parts of oil of vitriol (diluted with water) for every three parts of slaked lime previously employed, the action being promoted by steam heat and brisk agitation; after repose the liberated fat is decanted from the sediment (sulphate of lime) and water, and is then well washed with water and by blowing steam into it; it is next allowed to cool, when it is reduced to shavings by means of a number of knives worked by machinery, and in this divided state is placed in canvas bags and submitted to the action of a powerful hydraulic press, by which a large portion of the oleic acid which it contains is expelled; the pressed cakes are then a second time exposed to the action of steam and water, again cooled, and coarsely powdered, and again sub-

mitted to the joint action of steam and pressure; they are, lastly, melted and cast into blocks for sale.

Obs. This product is a more or less impure mixture of stearic acid and other fatty bodies, particularly the so-called margaric acid now generally regarded as a mixture of palmitic and stearic acids. The hard fatty acids of vegetable origin (palmitic, cocinic, myristic, etc.) now so extensively used as candle materials are obtained from the natural oils and butters by the process known as "sulphuric-acid saponification," which consists in treating the fatty bodies with 5 or 6 p. c. of concentrated sulphuric acid at a high temperature (about 350° Fahr., produced by superheated steam), and distilling the resulting mass by the aid of steam heated to about 560° Fahr. Frequently the operations of hot and cold pressing are resorted to in order to free the product from the softer fats.

By a patent process employed at Price's Candle Works the natural vegetable fats are decomposed into their constituents (fatty acids and glycerine) by the action of superheated steam alone, without previous "saponification" with lime or sulphuric acid.

1690 Another method for the preparation of commercial stearic acid is that of Messrs. Monier and Bontigny. This process is thus described in the Chemical Technology of Messrs. Ronalds and Richardson: Two tons of tallow and 900 gall. of water are intoduced into a large rectangular vat of about 270 feet capacity.

The tallow is admitted by means of steam admitted through a pipe coiled around the bottom, and the whole kept at a boiling heat for an hour, during which a current of sulphurous acid is forced in. At the end of this period 6 cwt. of lime, made into milk with 350 gall. of water are added. The mixture soon acquires consistence, and becomes frothy and viscid. The whole is now agitated in order to regulate the ebullitions and prevent the sudden swelling up of the soapy materials. The pasty appearance of the lime soap succeeds, and it then agglomerates into small nodular masses.

The admission of sulphurous acid is now stopped; but the injection of the steam is continued until the small masses become hard and homogeneous. The whole period occupies eight hours, but the admission of sulphurous acid is discontinued at the end of about three hours. The water containing the glycerine is run off through a tube into cisterns prepared to receive it.

The arrangements for preparing sulphurous acids are retorts into which are put sulphuric acid and pieces of wood: upon the application of heat the sulphurous acid passes off, and is conveyed by leaden pipes into the vessels containing the tallow. The lime soap formed is then moistened with 12 cwt. of sulphuric acid, at 150° Fahr., diluted with 50 gall. of water. The whole is thoroughly agitated and the steam cautiously admitted, so as not to dilute the acid too much until the decomposition is general at all points. This occupies about 3 hours, and in two or three hours more the

1691 sulphate of lime has collected at the bottom, while the fatty acids are floating on the surface of the solution of the bi-sulphate of lime. Several processes of washing with steam and water are necessary to ensure the removal of the sulphate of lime, etc., and

after settling for 4 hours the fatty acids are forced through a fixed siphon into a vat, where they are again washed with water; they are then siphoned at last into a trough lined with lead, on the bottom of which are placed leaden gutters, pierced below by long pegs of wood. The fatty acids are then placed in cloths and subjected to pressure in the stearine cold press.

In 1871 Professor Boek, of Copenhagen, after a careful microscopic and chemical investigation, discovered that the neutral fats were composed of a congeries of little globules encased in albuminous envelopes. To the presence of these latter substances in the fat he attributed the difficulty of eliminating the fatty acids from it, either by means of sulphuric acid, except in excess, or of alkali, except under great pressure, conceiving that both these agents as employed under the usual methods were expended in rupturing and destroying the albuminous coverings.

The inconveniences arising from the above processes are, in the case of the excess of sulphuric acid, a considerable destruction of the fatty acid as well as the necessity of its distillation, and the consequent danger of conflagration, whilst in the case of the alkali this must either be used in quantities much greater than theory requires or else be heated under great pressure, at the risk of giving rise to an explosion.

In Professor Boek's process these dangers, together with the waste of material, are avoided. By submitting the fat for a limited time, and at a given temperature to the action of a small quantity of sulphuric acid the albuminous envelopes are broken and partly destroyed.

1692 The neutral fat thus liberated is then placed in open tanks in water, by which, after the expiration of several hours, it becomes decomposed. When this is completely effected the glycerine dissolved in the water used for the decomposition is removed, the fatty acids which remain behind, and which amount to 94 per cent. of the original fat, being at this stage of the operation dark brown or blackish in color.

In this condition they are placed in open tanks, and dilute solutions of certain agents are poured upon them, whereby the albuminous débris, as well as the coloring matters with which they are associated, becomes oxidized, whilst the specific gravity of these latter is in consequence so increased as to cause them to subside to the bottom of the tank, leaving the fatty acids, now greatly whitened, on the upper part of the liquid.

The acids, after being washed 2 or 3 times with dilute acid and water, are then cooled and hot pressed in the usual manner, and the stearic acid thus obtained is said to have a higher melting point, and to be larger in yield than that obtained by any other method, an oleic acid of excellent quality being at the same time produced.

In 1874 a French patent was taken out for an improvement in the manufacture of stearic acid. The patentee employs carbon disulphide to increase the fluidity of the oleic acid, so that the warm pressure of the crude stearic acid is avoided. The addition of the carbon disulphide may be made either before or after the cold pressing of the stearic acid. The crude fat acid is melted in a special

apparatus, and 20 per cent. of the disulphide is mixed with it whilst in the fluid state. It is then left to cool and subjected to cold pressure. The stearic acid thus obtained should be free from oleic acid.

Prop., etc. Pure stearic acid crystallizes in milk-white needles, which are soluble in ether and in cold alcohol, and forms
1693 salts with the bases, called stearates. The commercial acid is made into candles. See candles, fat, oils (fixed), and tallow.

"DEFENDANTS' EXHIBIT No. 24."

Payen, German Edition, 1874.

(Handbuch der Technischen Chemie, nach A. Payen's Chimie Industrielle frei bearbestet von F. Stohmann und Carl Engler. Stuttgart, 1874, vol. 1, p. 690.)

Saponification by means of very little lime, and the simultaneous use of steam under pressure.—De Milly has found that the decomposition of tallow can be just as perfectly effected if only 3 instead of 14 per cent. of lime to 100 of tallow are used, and temperature is raised to 172° in closed boilers by means of steam under pressure, which corresponds to a pressure of 8 atmospheres. The main advantage of this process consists in the fact that the subsequent consumption of sulphuric acid is diminished in proportion.

The explanation of this behavior of fats with regard to a small quantity of lime is to be found in the circumstance that even high-pressure steam alone, as has been described more in detail, p. 679, decomposes fats into glycerine and fatty acids, in causing them to take up water. According to this, the small quantity of lime in this process has only a subordinate effect; it prevents the reformation of glycerides through the reaction of the two nascent substances, glycerine and fatty acid, on each other.

(Then follows a description of process much shorter than in French edition.)

1694 "DEFENDANTS' EXHIBIT No. 25."

Wilson & Payne Patent, 1855.

DEPARTMENT OF THE INTERIOR,
UNITED STATES PATENT OFFICE.

To all persons to whom these presents shall come, Greeting:

This is to certify that the annexed is a true copy from the bound volumes of this office of the specification in the matter of the English letters patent granted George Fergusson Wilson and George Payne, February 8th, 1855, No. 301, for improvement in treating glycerine.

In testimony whereof I, E. M. Marble, Commissioner of Patents, have caused the seal of the Patent Office to be affixed this 9th day of June, in the year of our Lord one thousand eight hundred and eighty-three, and of the Independence of the United States the one hundred and seventh.

[SEAL.]

E. M. MARBLE,
Commissioner.

A. D. 1855. No. 301.

Distillation of glycerine.

Letters patent to George Fergusson Wilson, of Belmont, Vauxhall, managing director of Price's Patent Candle Company, and George Payne, of the same place, for the invention of "improvements in treating glycereine."

Sealed the 17th of April, 1855, and dated the 8th of February, 1855.

1695 Specification in pursuance of the conditions of the letters patent filed by the said George Fergusson Wilson and George Payne in the great seal patent office, on the 4th of August, 1855.

To all to whom these presents shall come, we, George Fergusson Wilson, of Belmont, Vauxhall, managing director of Price's Patent Candle Company, and George Payne, of the same place, send greeting:

Whereas Her most Excellent Majesty Queen Victoria, by her letters patent, bearing date the eighth day of February, in the year of our Lord one thousand eight hundred and fifty-five, in the eighteenth year of her reign, did, for herself, her heirs, and successors, give and grant unto us, the said George Fergusson Wilson and George Payne, her special license that we, the said George Fergusson Wilson and George Payne, our executors, administrators, and assigns, or such others as we, the said George Fergusson Wilson and George Payne, our executors and administrators and assigns, should at any time agree with, and no others, from time to time, and at all times thereafter, during the term therein expressed, should and lawfully might make, use, exercise, and vend within the United Kingdom of Great Britain and Ireland, the Channel Islands, and Isle of Man, an invention for "improvements in treating glycerine," upon the condition (amongst others) that we, the said George Fergusson Wilson and George Payne, by an instrument in writing under our hands and seals, or under the hand and seal of one of us, should particularly describe and ascertain the nature of the said invention and in what manner the same was to be performed, and cause the same to be filed in the great seal patent office within six calendar months next and immediately after the date of the said letters patent.

Now know ye that we, the said George Fergusson Wilson
1696 and George Payne, do hereby declare the nature of the said invention and in what manner the same is to be performed to be particularly described and ascertained in and by the following statement thereof—that is to say:

"Heretofore glycerine has been for the most part obtained when manufacturing soap, but in modern times glycerine has been obtained by other processes, amongst others by distilling it over with fat acids; but we have found that glycerine, even when distilling it over with fat acids, is not so pure as it is desirable to obtain glycerine, and glycerine obtained by other processes is generally very impure.

"Now, our invention consists of distilling and redistilling glycerine after it has been separated or for the most part separated from the fatty bodies previously combined with it. We distill glycerine in stills from which atmospheric air can be excluded, and we prefer to use superheated steam for the purpose of excluding the air from glycerine when and for aiding in distilling it. We also use steam in driving off the more volatile impurities from glycerine."

Having thus stated the nature of our said invention, we will proceed to describe the manner of performing the same.

This invention, as above stated, consists of purifying glycerine by distillation after it has been separated or for the most part separated from the fatty bodies previously combined with it, by which means we are enabled to produce glycerine in a much higher state of purification than heretofore. And the invention also consists of separating the more volatile impurities from glycerine by passing streams of steam through glycerine. In distilling glycerine we first concentrate it in a still, or like description of close vessel, to about the specific gravity of 1.15, conducting such concentration at as low a temperature as may be, say not exceeding 230° of Fahrenheit, the vapors passing from the still or vessel to a condenser to be condensed.

1697 Then for several hours currents of heated steam at a temperature of 212° to 230° Fahrenheit are to be introduced below the glycerine by a perforated pipe or other convenient means till the products passing over cease to indicate acid to test paper. The external heat is then raised to a temperature of about 230° of Fahrenheit, when superheated steam is to be freely admitted, when it will be found that the glycerine begins to distill at a temperature of about 340°, and we find the best results are obtained by keeping the temperatue of the glycerine in the still or vessel at a temperature of about 370° Fahrenheit, and we prefer to keep the temperature below 400° of Fahrenheit, as at that temperature, or slightly above, glycerine appears partially to decompose.

By distilling glycerine after it has been separated from the fatty bodies with which it had been previously combined, whether such separation has been accomplished by distillation or otherwise, glycerine of a high degree of purity is obtained. We would, however, state that where so great a degree of purity as that obtained by distillation and redistillation is not required a considerable degree of purity will be found to result from simply concentrating the glycerine and passing currents of steam through it for several hours, as above described, and then filtering the glycerine through washed animal charcoal.

Having thus described the nature of our invention and the manner of performing the same, we would have it understood that we do not confine ourselves to the precise details herein described, but what we claim is the subjecting glycerine to a process of distillation after it has been separated from the fatty matters previously combined with it; and we also claim the subjecting glycerine after it has been separated from the fatty bodies previously combined with it to the action of streams of steam.

1698 In witness whereof we, the said George Fergusson Wilson and George Payne, have hereto*fore* set our hands and seals this fourth day of August, in the year of our Lord one thousand eight hundred and fifty-five.

[SEAL.] GEO. F. WILSON.
[SEAL.] GEORGE PAYNE.

Ex'd: E. B. Q. E. M. M.

Witness:
B. GOBEY,
41 *Old Square, Lincoln's Inn.*

(Here follows diagram marked pp. 1699, 1700, 1701.)

1702 "*Context of Defendants' Exhibit No.* 2."

Wagner's Year Book, 1863, p. 664.

"The sentence printed in italics is the whole of Defendants' Exhibit No. 2."

On the industrial value of the preceding apparatus doubts have here and there been expressed; but a publicly performed experiment by Cloetz, in the Museum d' Histoire Naturelle, at Paris, has entirely set aside these doubts. In a small apparatus of the above-described construction (Wright & Fouché's apparatus), 8 kilo of tallow and 16 litres water were brought into circulation for 8 hours at a pressure of 15 atmos. and a temperature of 200° C. The product of 97.5 per cent. was obtained of beautifully white and hard fat acid, which contained scarcely traces of a saponified substance. The excellence of the substance obtained by Cloetz proves the value of the new process, and shows that if in practice the apparatus has sometimes yielded imperfectly saponified product, the fault must be ascribed to accidental circumstances, for example, of a too small quantity of water or a too low temperature, for, in the saponification by superheated water, two conditions are especially indispensable, namely, the most intimate and emulsion-like mixture of the fat and water, and the use of a sufficiently high temperature. With all apparatuses proposed care has been taken to keep carefully to the first condition.

In regard to the necessity of a certain temperature it follows with certainty, from the truly classic researches of Berthelot, that, if at a certain temperature the neutral fats are decomposed by water into fat acid and glycerine, at a lower temperature a reunion takes place of the separated products into neutral fat.

1703 If, now, when operating on a large scale, too low a temperature and pressure be employed, especially in the presence of a too small quantity of water, it is intelligible how, with a continued contact between fat acid and concentrated glycerine solution, a certain amount of neutral fat can form and depress the melting point of the product obtained.

"COMPLAINANT'S EXHIBIT No. 10."

Report of Juries.

Reports of Juries of London Exhibition of 1851.

Theory of the Formation of Soap.

P. 606. * * * The oleates of potash or soda, when separated from the water by processes immediately to be discussed, are what we call in common life soaps.

Similar soaps are formed by the remainder of the fatty acids; for example, stearic and margaric acid.

Palmitate of soda, obtained by boiling palm oil with soda, likewise forms a chief ingredient of many soaps.

* * * * * * *

Processes for the Manufacture of Soap.

P. 607. * * * The ordinary method is called the "large boiler process," as it is usually conducted on a very large scale, in boilers capable of holding many tons. A quantity of weak soda lye is put into the iron or copper boiler and raised to the boiling point, and the whole of the fat is generally added at one time. The ebullition is then carried on for some hours, and when the lye has become exhausted of its alkali, it is pumped away and a fresh portion of lye is added. After repeated boilings and pumpings, the saponification is completed and the soap is brought to strength by boiling down.

(Here follows diagrams marked pp. 1704, 1705, 1706, and 1707.)

1708 "COMPLAINANT'S EXHIBIT No. 11."

Morfit on Soap and Candles, 195.

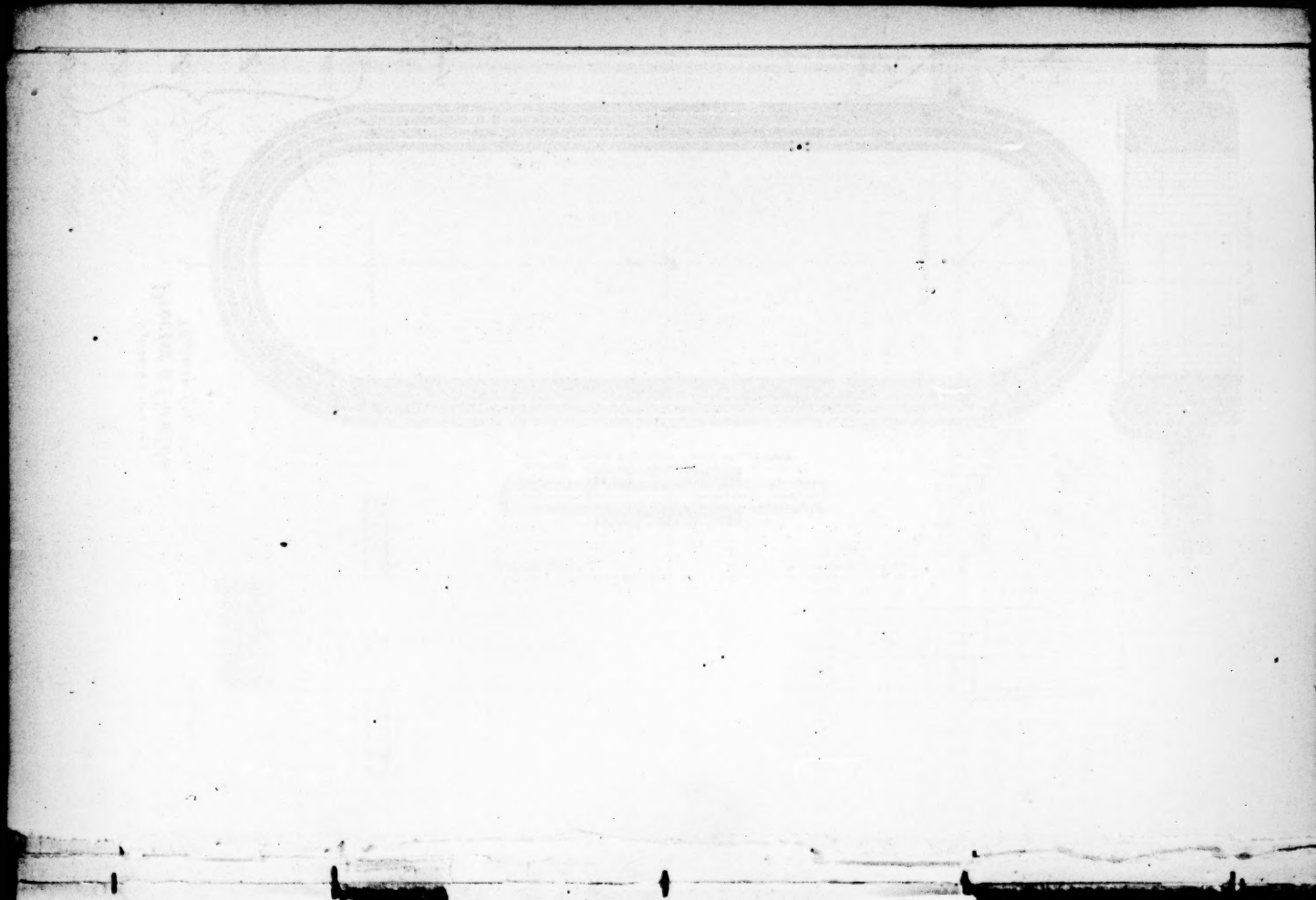
Morfit on Soap and Candles, Phila., 1847; p. 195. The process of soap making.

3. The relargage.

Having in the preceding process used a large quantity of water, which was required for the ample saponification of the fat, the next step is to withdraw it when it is no longer needed. This operation is effected by adding those leys that contain marine salt. Having poured these in, you then boil the mixture for about 15 or 20 hours. The fire being extinguished, the compound is allowed three or four hours' repose before the epinage, or the settled waste ley is drawn off. During the relargage, the workman, standing on the top of the brickwork should continually stir the contents of the caldron. When the mass opens in different places the relargage is complete, and you then proceed to the next step.

4th. The coction, or final boiling of the paste.

Again add to the caldron ley charged with marine salt; boil the mixture gently, and take care to scrape from the sides of the kettle any adhering soap, so that all portions may have the benefit of this



Nos. 883 & 895.
Tilghman
v.
Proctor et al.
&
Proctor et al.
v.
Tilghman

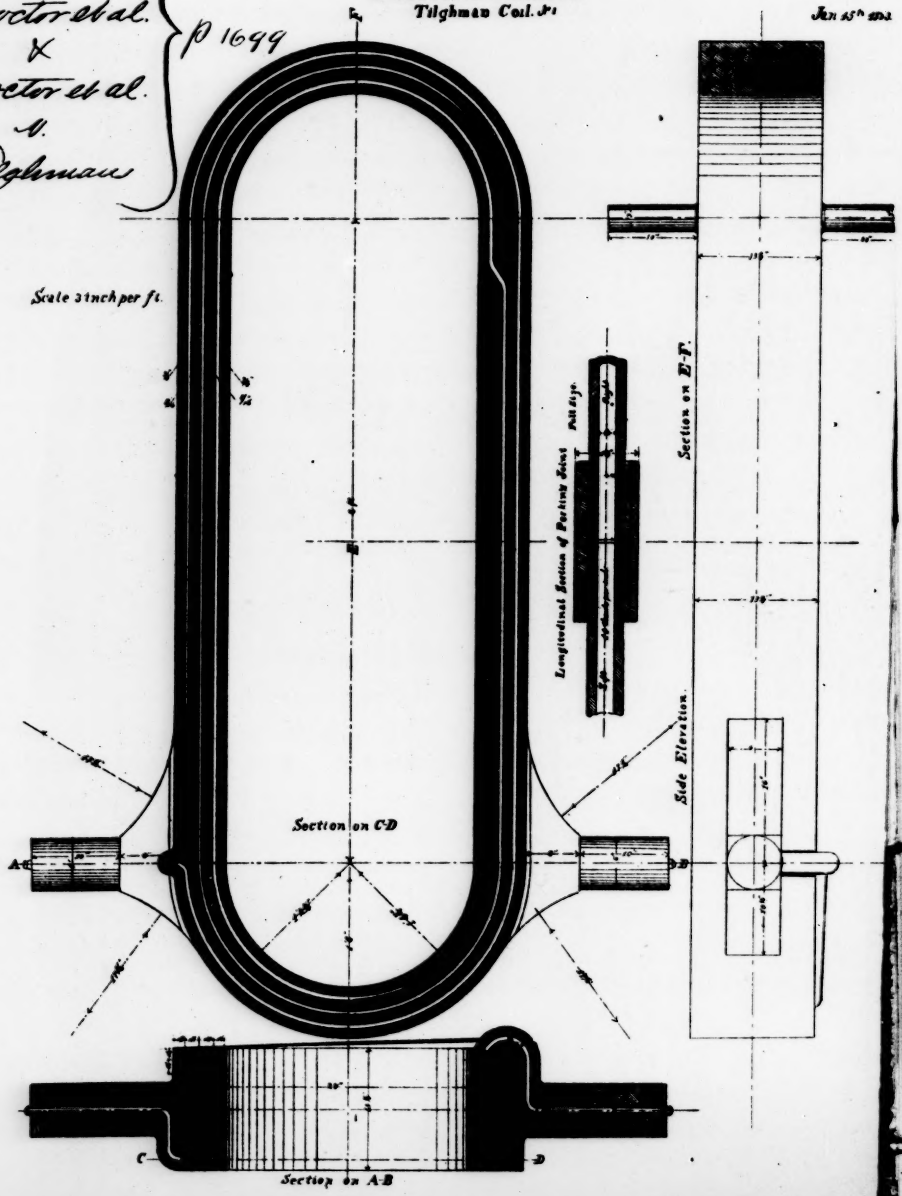
p 1699

Defendants Exhibit No. 26

Procter & Gamble.

Tilghman Coil. No. 1

Jan 15th 1883



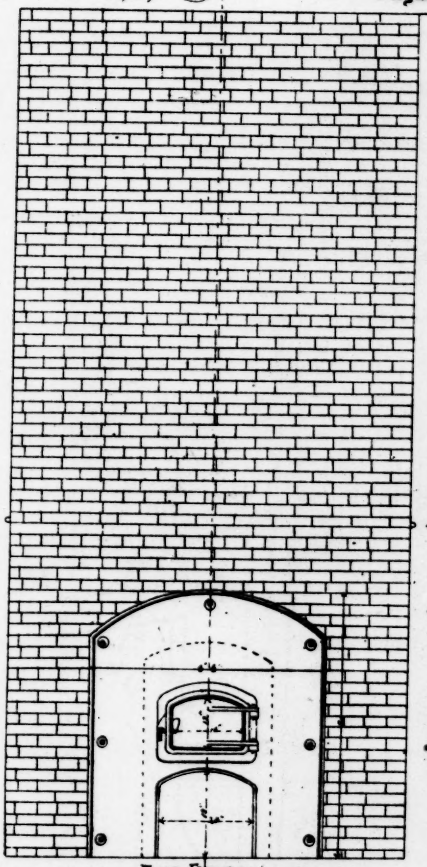
No 883 & 895
Tilghman
v.
Proctor et al.
&
Proctor et al.
v.
Tilghman.

p. 1700

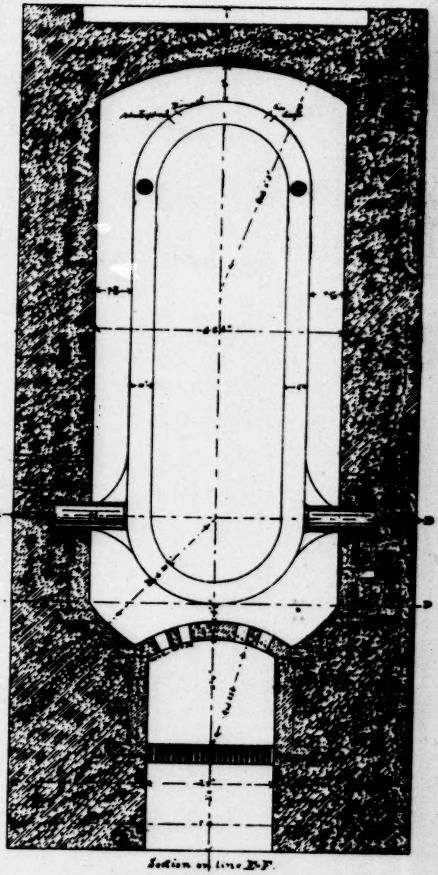
Procter & Gamble.

Tilghman Coil. No 2

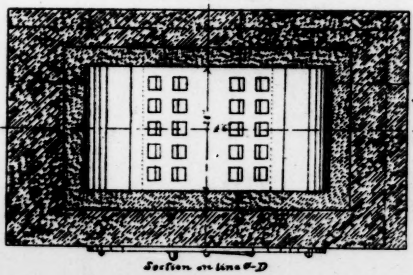
Jan 9th 1883



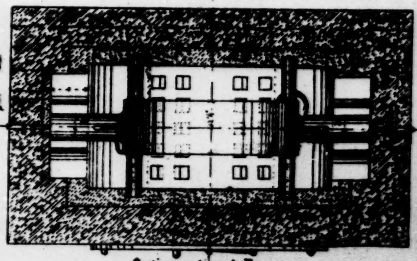
Front Elevation



Section on line E-F.



Section on line C-D



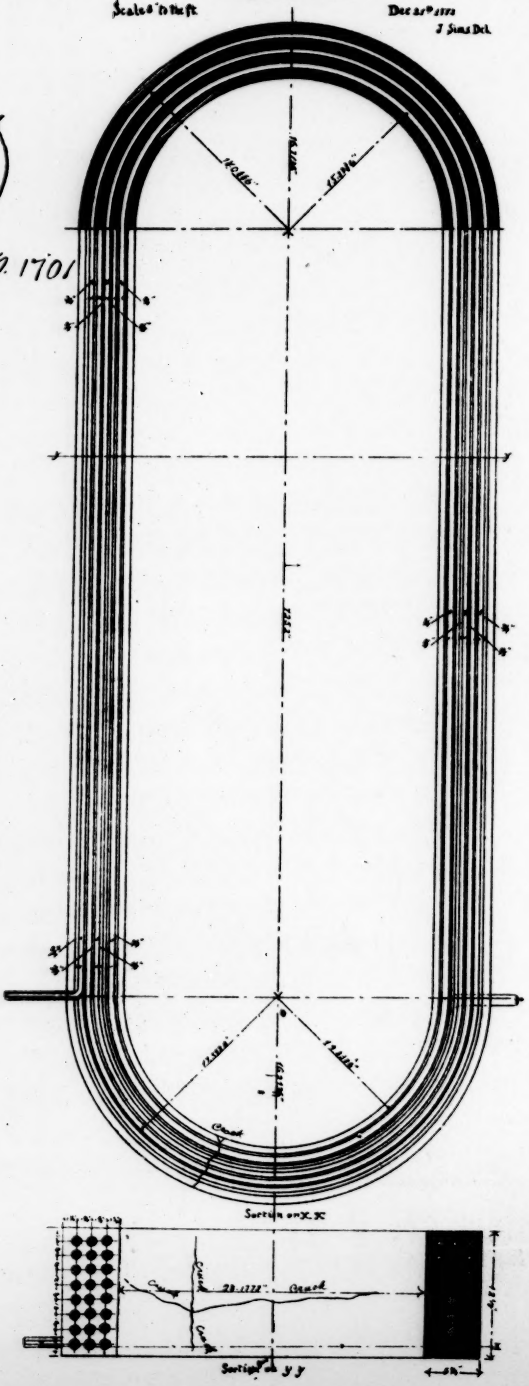
Section on line A-B

Procter & Gamble.

Tilghman Coll. No 3

Nos. 883 & 895.
Tilghman
v.
Procter et al.
&
Procter et al.
v.
Tilghman.

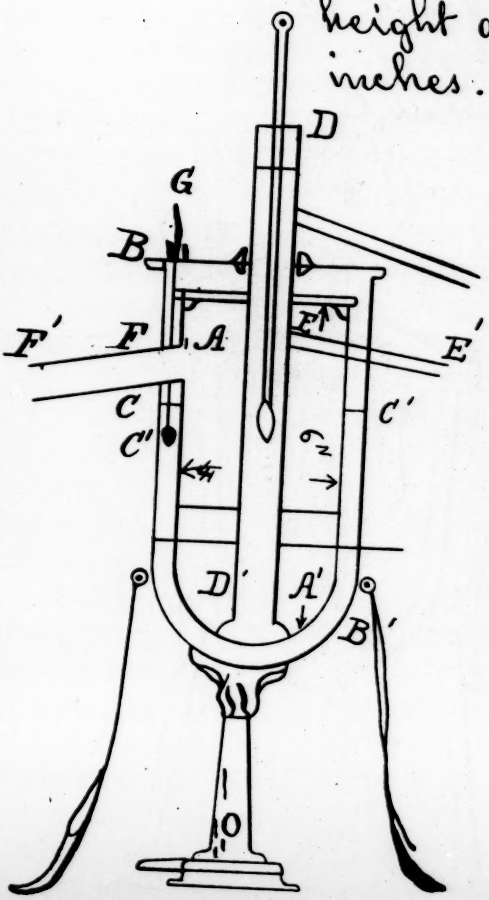
fo. 1701



"Defendants Exhibit No 29 Eb."

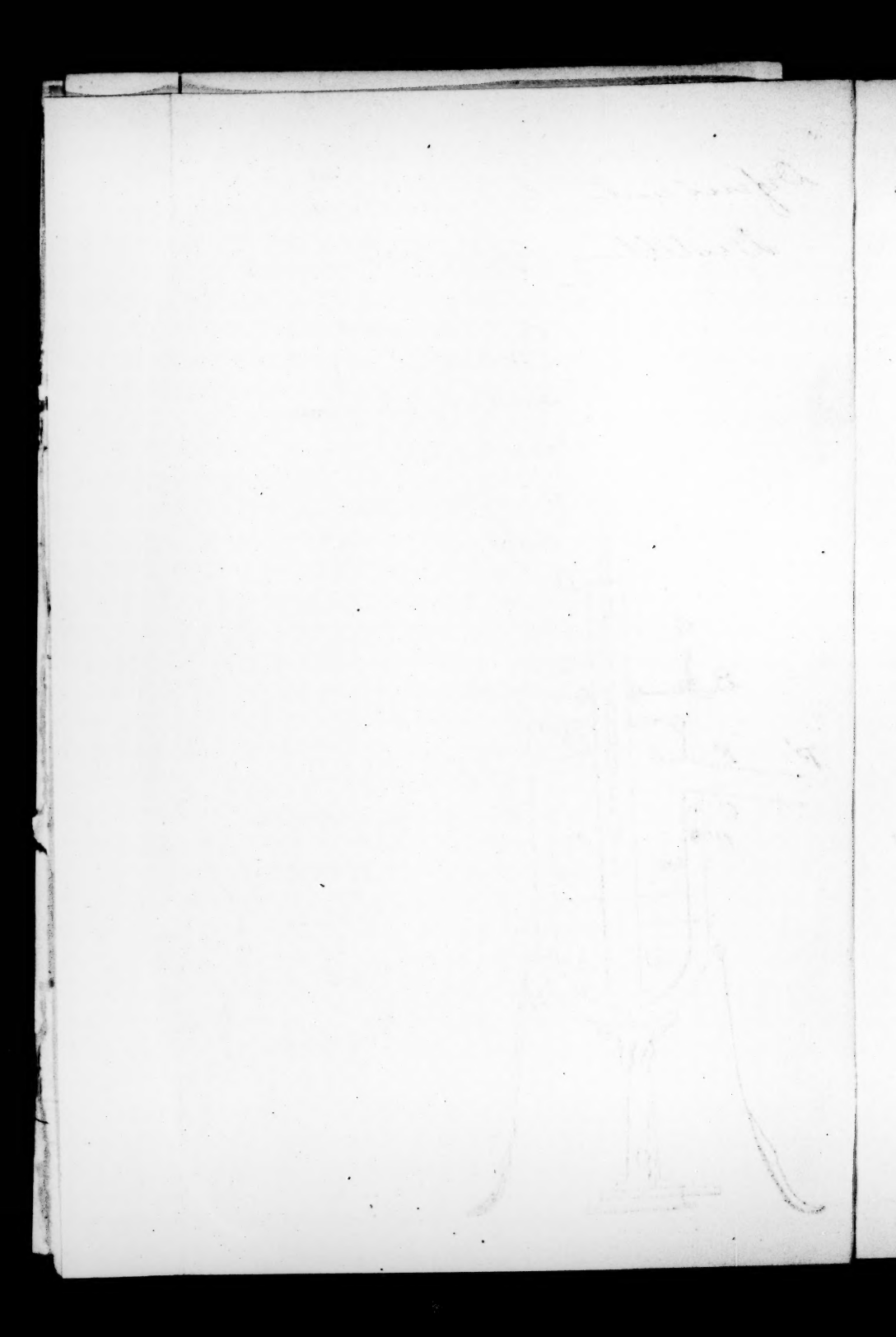
Distilling Apparatus

Diameter of inner vessel about four inches and height about six inches.



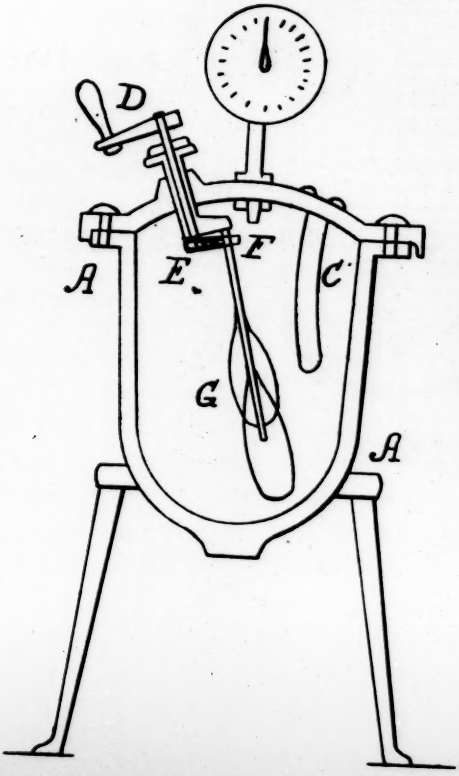
Nos. 883 & 895.
Tilghman
v.
Proctor et al.
&
Proctor et al.
v.
Tilghman

p. 1704.



"Defendants Exhibit No 30."
Labratory Digester.

Diameter of top about 15 inches and height of vessel about 15 inches.



Nos. 883 & 895.
Tilghman
v.
Proctor et al.
&
Proctor et al
v.
Tilghman

p 1705

R. A. Tilghman.

1706

Decomposing Fat.

No. 28,315. Patented May 15, 1860.

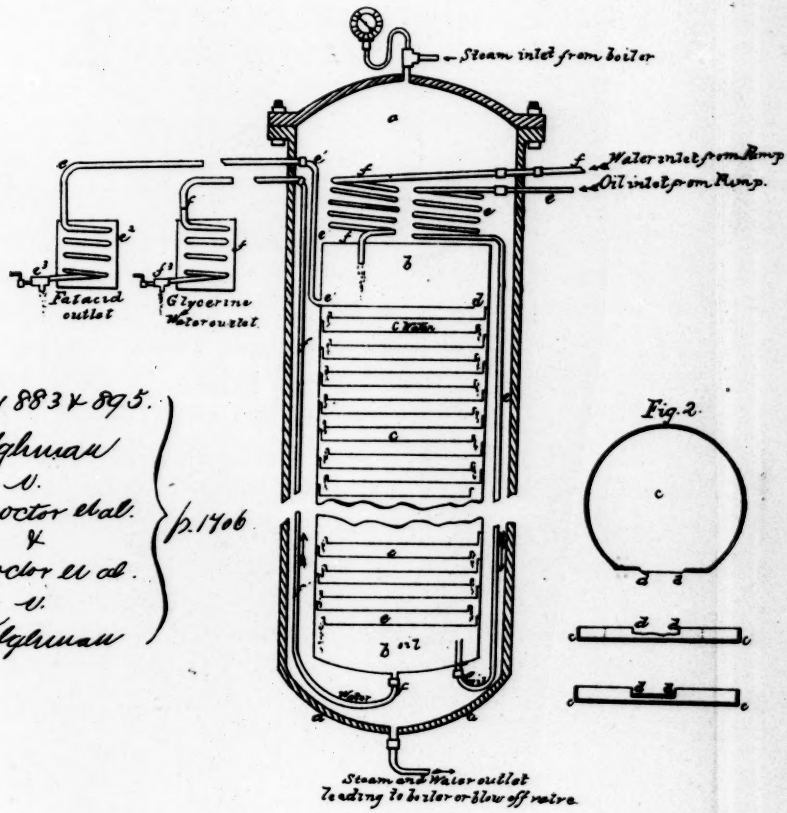


Fig. 2.

Nos 883 & 895.
Tilghman
v.
Proctor et al.
&
Proctor et al
v.
Tilghman

p. 1706

Witnesses
Elizabeth Tilghman
Maria Tilghman

Inventor,
R. A. Tilghman

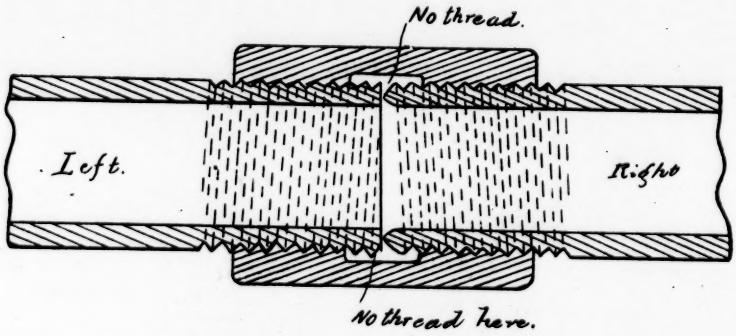
"Defendants Exhibit No 31
Drawing from Appellants brief

Nos. 883 & 895.
Tilghman
v.
Procter et al.
&
Procter et al.
v.
Tilghman.

p. 1704

Complainants Exhibit No. 21

PERKIN'S JOINT.



Lot 1

process; by this the mass acquires more consistence. After some hours' repose the settled ley is again drawn off. Again pour into the caldron ley of 20°, and keep up the fire until the paste boils; by this it acquires a still greater consistence. After continued boiling for about three hours, give it sufficient time to settle, and again draw off the waste ley. Repeat this operation once more, but with strong leys, taking care to continually stir the paste while being heated, in order that the lower strata may be so mixed with the upper as to form a homogeneous mass. The fire should be so managed as only to produce a gentle ebullition. It is then that
1709 the soap commences to acquire firmness. That the coction may be perfect it is requisite to repeat this operation four or five times.

P. 434. Stearic acid candles.

The operation finished, the steam is stopped off and a quantity of cold water added, gradually at first, whilst the stirring shafts are in constant motion. The whole is soon converted into a granular mass, and after being well washed, is ready in the same vat for the next step, and without being transferred to another vessel. To effect this washing there should be a vent hole at the bottom of the saponifying tun, and plugged up with a movable wooden stopper. There should also be placed behind the hole a piece of brass or copper wire cloth, so that when the water is being drawn off there may be no waste of the soap by an escape of small particles.

By withdrawing this plug the water first added can be drawn off; when it is out the opening should be closed up, and the mass washed with fresh water; after another evacuation of the water repeat the washing until the soap has been three times cleansed. In this way you get rid of all the glycerine, and put the soap in a state to be acted on without hindrance at the next stage of the process.

P. 435. As the fatty acids are more or less contaminated with salts, you must now throw over them a portion of warm water (heated by the waste steam of the boiler in a cistern kept exclusively for that purpose), and agitate the whole for some time by the revolutions of the teethed shaft. That done, after having remained a sufficient time to settle, the saline water is drawn off, as above directed, and this washing with hot water again repeated several times, or until the fatty acids have become entirely free from alkaline or saline matters.

1710 "COMPLAINANT'S EXHIBIT NO. 12."

Ure's Dictionary.

Ure's Dictionary of Arts, Boston, 1853, v. 2, p. 673. Title, Soap.

To this lye a quantity of tallow is added and the whole boiled for some time, or until upon testing it the lye is found to have lost its caustic property. The whole is now allowed to cool and remain at rest, until the lye now deprived of its alkali settles to the bottom of the copper, whence it is pumped out by a kind of force-pump, as the excise regulations do not permit it to be withdrawn or run off as

it is in other countries from the bottom of the boiler. This fluid is denominated spent lye, and contains a portion of glycerine derived from the fat or tallow, together with the sulphate and muriate of soda of the soda ash, and an additional quantity of muriate of soda added by the soap-maker.

The presence of this muriate of soda is indispensable, for otherwise the tallow and lye would unite into a uniform emulsion, from which it would be impossible afterwards to separate the spent lye; but as soap is altogether insoluble in a solution of common salt, the partially saponified compound is thus brought to float on the surface, and permits of the spent lye precipitating to the bottom, from whence, as we have seen, it is pumped away and lost, being of no value.

This constitutes what is called an operation, and after continuing to repeat these operations three or four times with lyes of gradually increasing strength a period arrives at which the grease is said to be "killed," or, in other words, the tallow is saponified or combined with its full equivalent of soda. This point is well known to the workmen by the consistence of the compound, when a little
1711 of it is squeezed between the finger and thumb and allowed to cool; if finished it readily separates from the skin as a hard cake, and moreover has no longer the taste peculiar to grease; if, on the contrary, any tallow remains unsaponified, this oozes out by the pressure and becomes perceptible both to the sight and taste. A more certain mode, however, is to decompose a portion of the suspected soap by means of an acid, and ascertain whether the resulting grease is wholly soluble in boiling spirits of wine, for, if not, the saponification has been imperfect.

"COMPLAINANT'S EXHIBIT No. 13."

Roret's Encyclopædia, 112.

Roret's Encyclopædia, Stearic Candles, Paris, 1849, p. 112.

While admitting the necessity of the agitation of the mass to be saponified, we believe that we ought to remark that in the other kinds of saponification experience has demonstrated that we cannot succeed in saturating completely and economically the fatty bodies except by saponifying them in two periods of time (*en deux temps*). In fact, the fatty bodies are not soluble in water, and in general chemical decompositions do not often take effect thoroughly (*avec nettete*) except when one of the substances is in complete solution in that liquid. In the soap manufacture this is the object of the operation which is called the "empatage," which is intended to form, by means of a small quantity of the alkali, an emulsion with the fatty matter to be saponified, and to prepare it to combine with a larger quantity of the alkali during the operation which is called the "coction."

Again, there is another consideration which prescribes to some extent — to make the saponification at two periods, or at least to

1712 make several periods in this operation; it is that the lime soap which is formed by the simultaneous mixture of the whole quantity of lime intended to be used on the fat acquires a great density, and in precipitating it envelopes part of the unsaponified fat, which is thus withdrawn from the action of the lime; hence arises the necessity of almost continual agitation to break and disintegrate these masses of soap, and to put all parts of the fat in contact with the lime. We insist, then, on the adoption of this saponification in two or more periods.

It appears, besides, that this idea has not escaped certain manufacturers, for Prof. Joeckel, in his description of the German manufacture of stearic candles, published in 1841, writes thus: Everybody knows that the manufacture of stearic candles commences by the saponification of the tallow. With this object we melt the tallow with a sufficient quantity of water in a suitable tub heated by steam, and while the heat is slowly rising we add, in the form of milk of lime, such a quantity of the lime as will suffice to saturate all the free acids which we suppose to exist in the tallow and which are not combined with glycerine. The addition of a larger quantity of lime at the beginning of the operation, and especially at the moment when the heat is rising rapidly, would act in a disadvantageous manner, because it would hasten too much the formation of the lime soap and would be the cause that a part of the undecomposed tallow would find itself withdrawn from the action of the lime. In consequence, while the heat is rising, we ought not to give all the required quantity of lime at one time, but to reserve a portion which we add by degrees, allowing the substances to combine together, under the influence of the continual current of steam, until the lime soap is completely formed; we know that this point is arrived at, and that the operation is finished by the almost instantaneous change which takes place in the consistence of the liquor,

1713 which begins to precipitate granular masses of a sharp fracture.

Besides, it is necessary not to neglect the other significant signs which are observed in the manufacture of common soap from tallow. The quantity of lime necessary to saponify 100 kilograms of tallow can be fixed without fear at 14 kilograms. Another useful observation is presented, viz., that the saponification of fats by lime can scarcely be executed rapidly and completely, except under a pressure greater than that of the atmosphere.

(Here follows the remainder of the extract from Roret, as printed on pages 474, 475, Supreme Court record.)

"COMPLAINANT'S EXHIBIT No 14."

Muspratt's Chemistry, vol. 2, p. 879.

Muspratt's Chemistry, 2d vol., p. 879—title, Soap.

The next step in the process is the removal of the large quantity of water which was required for the ample saponification of the fat. This is effected by the addition of lyes containing common salt, and afterwards boiling the mixture from 15 to 20 hours, constantly stir-

ring during ebullition. When the mass opens in different places the separation is complete. The fire is withdrawn and the whole is now allowed three or four hours' repose, after which the settled waste lye is drawn off. A further quantity of lye charged with common salt is now added, and the mixture is gently boiled, being careful to remove from the sides of the caldron any adhering soap, so that all portions may be in contact with the lye. The mass now acquires more consistence. After some hours' repose the settled waste lye is again withdrawn. Lye of sp. gr., 1.10 = 20° Twaddell is
1714 poured in, and the mixture is again boiled; by this it acquires a still greater consistence. After continued boiling for about three hours it is allowed to deposit, and the waste lye is again drawn off. This operation is repeated once more, but with strong lyes, being careful to stir the paste while being heated, so that the whole may form a homogeneous mass, and allowing only a gentle ebullition. The soap at this stage begins to acquire firmness. The boiling with lye several times successively serves not only to complete the saponification, but to wash and purify the soap. That it may be perfect, it is necessary to repeat the operation four or five times.

COMPLAINANT'S EXHIBIT No. 15.

Roret's Encyclopædia, 109, 114.

Roret's Encyclopædia, Stearic Candles, Paris, 1849.

P. 109. The lime saponification is performed generally in wooden tubs of the capacity of 2,000 liters, more or less, according to the locality. These tubs are generally made of pine, as free as possible from knots or holes containing resin. We put in each of these tubs 500 to 600 kilog. of tallow, and pour on it 1,000 liters (1,000 kilog.) of water.

P. 14. We begin by running into the said boiler a quantity of water double that of the tallow to be saponified; in this water we put the tallow, and when this last is melted we spread over the liquid mass a milk of lime in quantity sufficient to effect the saponification of the fat.

1715 "COMPLAINANT'S EXHIBIT No. 16."

Muspratt's Chemistry, 1, 430.

Muspratt's Chemistry, vol. 1, p. 430.

In this tun the hydrate of lime is mixed with the oily fat in the proportion of fifteen per cent. of its weight, the lime being made into a moderately-thick cream with water, one and a quarter gallon to the pound of lime.

"COMPLAINANT'S EXHIBIT No. 17."

Morfit on Soap and Candles, 430.

Morfit's Soap and Candles, Phila., 1847, p. 430.

To commence the process for stearic candles, take, say, one 1,000

lbs. of common tallow or pressed lard, called in commerce "stearin-," and throw it into No. 1 of a series of large iron-bound, slightly-conical cedar cisterns, each of which is heated by a current of steam conveyed therein through branch pipes leading from a main conduit of larger size attached to the boiler; when melted pump it off into No. 2, and add 150 lbs. of good lime previously slaked and made into a whitewash with 200 gallons of water, and steam away steadily for five or six hours under a tight cover, which should fit closely over the cistern.

"COMPLAINANT'S EXHIBIT No. 18."

Pelouze and Fremy, 5—948.

Pelouze & Fremy, Traite de Chimie, Paris, 1865.

V. 5, p. 948. The soluble soaps are prepared either by directly uniting the fat acids with potash and soda or from the oils,
1716 fats, and tallows by boiling alkaline solutions. This operation, which constitutes saponification, requires much time and patience to bring it to completion. In the laboratories we prepare the soap of potash or soda by boiling in a porcelain vessel a mixture of 100 parts of neutral fat (olive oil, tallow, lard, etc.) with 20 or 25 parts of caustic potash or soda and 200 to 250 parts of water.

The mixture ought to be continually stirred with a glass rod; as fast as the water evaporates it is replaced by boiling distilled water. We recognise that the saponification is completed when a small quantity of the substance tested by pure water dissolves entirely without showing any trace of fatty matter. We also judge that the soap is well made when chlorhydric or sulphuric acids separate from it a fat acid entirely soluble in alcohol.

COMPLAINANT'S EXHIBIT No. 19.

Mohr, Redwood & Procter's Pharmacy, 488.

Mohr, Redwood & Procter's Pharmacy, Phila., 1849.

P. 488. Emulsions. An emulsion is a mechanical mixture having a milky appearance, if an oil, fat, or resin with water, the admixture being promoted and rendered more or less permanent by the presence of an alkali or gum or some equivalent substance, such as albumen or caseine.

"COMPLAINANT'S EXHIBIT No. 20."

Pelouze and Fremy, 5—951.

Pelouze and Fremy, Traite de Chimie, Paris, 1865, V. 5. p. 951.

Of all the soaps the most esteemed and the most employed in commerce is Marseilles soap. It is distinguished particularly by
1717 its marbling from other hard soap. Its manufacture which we are about to describe differs little from that of other soaps having soda as their base. * * *

This lye at 12° serves for the first "empatage" of the fatty bodies. It is followed by a second and a third "service" at 15° or 20°, which have for object to thicken the paste. This operation lasts ordinarily twenty-four hours. It has for object to determine an emulsion of the fatty body and a commencement of combination with the alkali.

1718 "COMPLAINANT'S EXHIBIT No. 24."

Specific Gravity of Glycerine Solutions.

Wagner's Year Book, 1880, p. 442.

Extract from W. Lenz's table of Sp., Gr., and strength of glycerine.

Anhydrous Glyc.	Sp. gr.
70	1.1889
69	1.1853
68	1.1826
67	1.1795
66	1.1764
65	1.1733
64	1.1702
63	1.1671
62	1.1640
61	1.1610
60	1.1582
59	1.1556
58	1.1530
57	1.1505
56	1.1480
55	1.1455
54	1.1430
53	1.1403
52	1.1375
51	1.1348
50	1.1320
49	1.1293
48	1.1265
47	1.1238
46	1.1210
45	1 1183
44	1.1155
43	1.1127
42	1.1100
41	1.1072
40	1.1045
39	1.1017
38	1.0989
37	1.0962
36	1.0934
35	1.0907
34	1.0880
33	1.0852
32	1.0825
31	1.0798
30	1.0771
29	1.0744
28	1.0716
27	1.0689
26	1.0663
25	1.0635
24	1.0608
23	1.0580
22	1.0553
21	1.0525
20	1.0498
19	1.0471
18	1.0446
17	1.0422
16	1.0398
15	1.0374
14	1.0349
13	1.0332
12	1.0297
11	1.0271
10	1.0245
9	1.0221
8	1.0196
7	1.0172
6	1.0147
5	1.0123
4	1.0098
3	1.0074
2	1.0049
1	1.0025

(Here follow diagrams marked pp. 1719, 1720, 1721.)

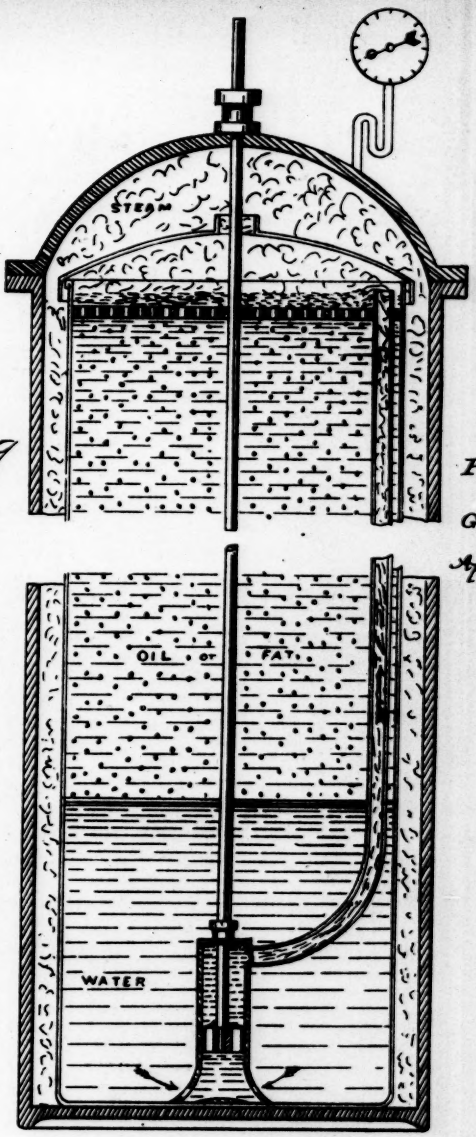
1722 And afterward, to wit, on the 5th day of September, in the year last aforesaid, came the complainant herein aforesaid, by

1719

84½

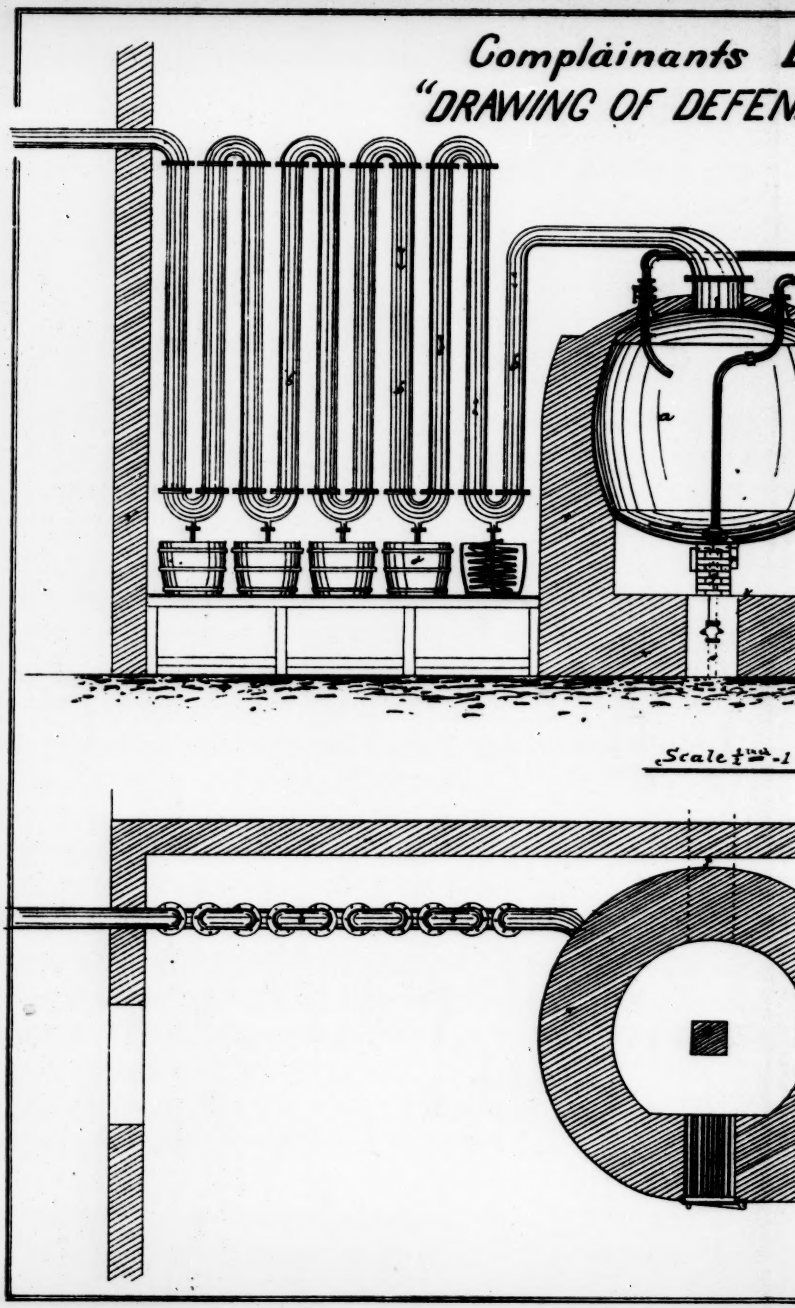
Nos 883 & 895.
Tilghman
v.
Procter et al.
&
Procter et al.
v.
Tilghman

p. 1719



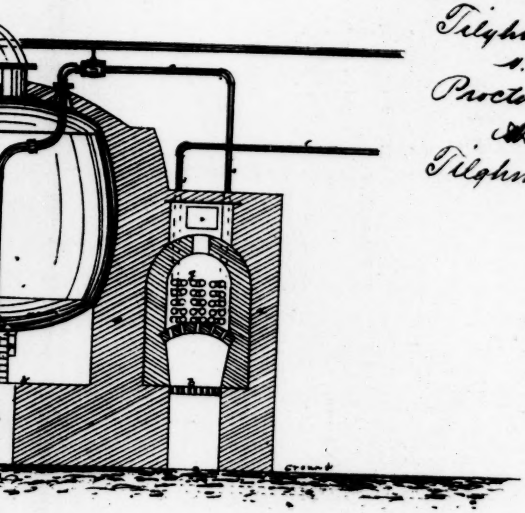
Proctor & Gamble's Apparatus

Drawing from Appellants brief referred to by President Morton in answer to Ques. 9 (page 254)
C Richards
Master

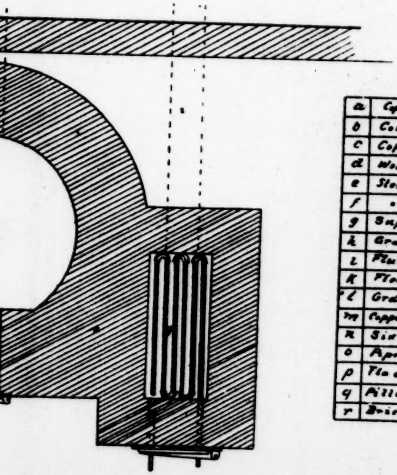

Complainants
"DRAWING OF DEFEN
Scale

ts Exhibit 22
EFENDANTS STILL"

No. 883 & 895
Tilghman
v.
Procter et al. p. 1720
&
Tilghman



1 inch = 1 foot.



a	Copper Still
b	Condenser
c	Copper Coil
d	Wooden Tub
e	Steam-Pipe from Supperheater in Still
f	" " " Boiler to Supperheater
g	Supperheater
h	Grateboars
l	Flue to Chimney
k	Floor of Grateboars
l	Grateboars
m	Copper-Pipe for Charging
n	Iron Pipes with Holes for Steam
o	Pipe for Clearing out residuum
p	Flue to Chimney
q	Pillar for Still
r	Brickwork

the said George Harding, Esq., and Francis F. Chambers, Esq., his solicitors, and filed in the clerk's office of the court aforesaid, in this cause, his certain exceptions to the said report of the said special master, clothed in the following words and figures, to wit:

Exceptions of Complainant to Master's Report.

Circuit Court of the United States, Southern District of Ohio. In Equity.

R. A. TILGHMAN
vs.
PROCTOR & GAMBLE. } No. —.

Exceptions taken by complainant to the report in this case prepared and filed on the 11th day of August, 1884, by Channing Richards, Esq., the master to whom the case was referred.

1st exception. For that the learned master erred in reporting the amount of the saving in chemicals by computing the said savings on the alleged average amounts of lime and acid employed in the old process by different manufacturers, whereas he should
1723 have reported that the defendants, while manufacturing under the old lime-saponification process, used 14 lbs. of lime to each hundred pounds of fat and three lbs. of acid to each pound of lime, and should have computed the saving to them by reason of their infringement at 13 lbs. of lime and 39 lbs. of acid for each hundred pounds of fat, giving for the total quantity of fat treated during the infringement:

3,031,957 lbs. of lime, at $.3526 per hundred	$10,690 54
9,095,948 lbs. of acid, at 2.526 per hundred	229,784 11
Total saving of chemicals	240,474 65

2nd exception. For that the learned master erred in reporting that no material economy in operation was secured by the defendants' change of process, whereas he should have reported that large savings inured to the defendants in the amount of product, the labor required, and in fuel by reason of their use of the patented process.

3rd exception. For that the learned master erred in report-
1724 ing that there is no testimony establishing the cost of concentrating glycerine water of a density of 3.4° B. to a density 3° to 3¼° B., and in reporting that the complainant was not entitled to recover the amount saved to respondents by reason of the greater strength of their crude glycerine water, whereas he should have reported that the testimony showed the cost of concentrating glycerine water of 3.4° to a density of 3° or 3¼° was not less than $94.93 to $1.07 per barrel of 3° or 3¼°, and that this amount had inured to the respondents as savings from their use of the patented process, amounting in all to at least $14,570.95.

4th exception. For that the learned master erred in reporting that the glycerine water sold by respondents was the product of the

first charge only of the water used by the respondents in their infringing process and was equal to be half the weight of the fat, and that in consequence the glycerine water of the old process was double the quantity of that sold by them during the infringement,
1725 whereas the master should have reported that the evidence showed that the glycerine water sold by respondents was practically equal in weight to the fat used, and certainly as great in bulk as the glycerine water produced by the old process. Applying this correction to the master's "Table B," the amount of gain by digesters, exclusive of cost of evaporation, should be $82,422.40 instead of $61,701.77, as reported by him in said table.

5th exception. For that the learned master erred in reporting that the operation and product of Mitchell's apparatus was not material to this case, whereas he should have reported that Mitchell carried on the complainant's process in an apparatus substantially similar to that used by respondents, the two forms of apparatus being at the date of complainant's patent well-known mechanical equivalents for effecting an admixture of fluids.

6th exception. For that the learned master erred in reporting that saponification of fats by water alone has never been regularly
1726 employed by any one in such digestion as the respondents used, whereas he should have reported that Mitchell, in a substantially similar apparatus, never used anything but water, and produced the best decomposition of any manufacturer in the country.

7th exception. For that the learned master erred in reporting that the product of the process as used by respondents was inferior in quality and value to the product of the old lime-saponification process, whereas he should have reported that while the comparative quality and value of the fat acids produced by lime saponification are not proved, there is every reason to *be* believe that they were notably inferior to those of the fatty acids of respondents' infringing process.

8th exception. For that the learned master erred in reporting that the alleged modifications of the patented process used by respondents, viz., the use of one per cent. of lime and a double dose
1727 of water are both shown to be efficient, whereas he should have reported that the said use of lime was shown by the evidence to be not only useless, but harmful, and the use of the water in two doses to be unnecessary.

9th exception. For that the learned master has erred in reporting that the evidence showed that the respondents, operating their digesters with water alone for nine and a half hours at a pressure of 225 lbs., obtained fatty acids inferior to those obtained by lime saponification, whereas he should have reported that the result of the experiment made by the respondents showed that, with water alone applied in a single dose equal to the quantity used by the respondents in the infringing process and heated to a pressure of 225 lbs., practically perfectly decomposed fatty acids were produced in eight and a half hours.

10th exception. For that the learned master erred in reporting

that any deduction should be made from the amount of the
1728 savings in chemicals accruing to respondents for the alleged modifications on complainant's process used by respondents, whereas he should have reported that the savings in chemicals accruing to respondents were entirely and solely due to their use of complainant's process.

11th exception. For that the learned master erred in reporting the amount of the gains and savings accruing to respondents from the use of complainant's process as $129,441.44, whereas he should have reported the net gains and savings accruing to respondents from their infringement, as from glycerine, at least ---- $93,494 28
Savings in chemicals ---- 240,474 65

Total ---- $333,968 93

12th exception. For that the learned master erred in reporting that the circumstances of this case are not such as to entitle the complainant to interest on the amount of savings found to have accrued to respondents by reason of their infringement, whereas
1729 he should have reported that the circumstances of this case are such as to render the allowance of interest on said savings eminently proper and advisable.

GEO. HARDING,
FRANCIS T. CHAMBERS,
Sol's & of Counsel for Complainant.

And afterward, to wit, on the 8th day of September, in the year last aforesaid, came said respondents, by their solicitors, and filed in the clerk's office of the court aforesaid, in this cause, their certain exceptions to the said report of the said special master herein, clothed in the following words and figures, to wit:

Respondent's Exceptions to Master's Report.

Circuit Court of the United States, Southern District of Ohio. Equity.

RICHARD A. TILGHMAN, Complainant,
vs.
WILLIAM PROCTOR *et al.*, Respondents. } 1877.

Exceptions taken by defendants to the report made in the above-entitled cause by Channing Richards, master, to whom this
1730 cause was referred by an order of this court made in the interlocutory decrees herein, and being the report dated July 1884, and filed on or about August 11, 1884.

Now come defendants herein, and except to the said report of said master for reasons as follows, viz:

The master erred—

First. In finding that the royalty of twenty cents per hundred was established as a royalty for the use of the invention embraced in the patent sued upon, whereas he should have found that the said royalty included the right to subsequent and material improvements, and was only particularly charg-able to said patent.

Second. In finding that complainants *were* entitled to recover interest on royalties and in awarding interest thereon.

Third. In finding and assessing damages in the amount of seventy-nine thousand five hundred and sixty-six dollars and seventy-one cents ($79,566.71).

1731 Fourth. In not finding that complainant, having failed to show what proportion of the royalties and profits under the patent accrued to him, was entitled to nominal damages only.

Fifth. In finding that the difference in the cost of manufacture betwee- the old processes and defendants' processes affords a measure of profits, gains, or savings accruing to defendants by reason of their said infringement, whereas he should have found that under the method of enjoying the franchise practiced by complainants the royalty withheld from complainant was the only profit accruing to defendants or withheld from complainant by reason of said infringement.

Sixth. In finding that the saving in cost of manufacture by the defendants' process is a profit received by or accruing to the defendants from infringing the exclusive rights of complainant.

Seventh. In finding that defendants have effected any savings, gains, or profits whatsoever by reason of said infringement, whereas he should have found that there was no saving, profit, or gain in the use of the invention embraced in complainant's patent

1732 over older methods of manufacture open to the public at the time.

Eighth. In finding savings, gains and profits upon a comparison between the old lime process and defendants' process, with all modifications and improvements introduced since the date of complainant's patent, whereas he should have found that the savings, gains, and profits recoverable herein are limited to those obtainable by practising complainant's invention in the manner exhibited and described in the patent unmodified by improvements thereon.

Ninth. In finding that complainant is not limited is this computation of profits to the profits obtainable by practicing the process with the apparatus exhibited in his patent.

Tenth. In failing to find that complainant's process, when practiced in accordance with the best method exhibited in the patent, or known at the date of the patent, was incapable of profitable competition in the market with the old modes of manufacture.

Eleventh. In finding that the patented process effected any saving in the cost of manufacture.

1733 Twelfth. In finding that complainant's process effected a saving in glycerine, whereas he should have found that the yield of glycerine by complainant's process, when practiced according to complainant's patent, was less in quantity and poorer in quality than by the old lime process.

Thirteen. In finding that it was found that satisfactory results could be obtained by complainant's process by using a small percentage of lime, whereas he should have found that no satisfactory results were secured by the process as exhibited in complainant's patent, either with or without lime.

Fourteenth. By finding that defendants secured a good quality of fat acid by the patented process modified by a change of water and a percentage of lime, whereas he should have found that it was only with additional modifications that any results of practical value were obtained.

Fifteenth. In failing to find that no satisfactory or profitable results were obtained by the patented process until it was modi-
1734 fied by subsequent inventions, and, among other things, by introducing steam within the digester, by mixing with the water a percentage of lime; by introducing within the digester a pumping apparatus effecting the constant flow of the lime water and fat in opposite directions through each other; by the passage of the water through a body of highly-heated steam before each return to the fat; by using the inner tank, confining the fat enveloped with highly-heated steam, and by its perforated diaphragm spreading the water in jets as it passes from the steam to the fat; by successive charges of water, and by a material reduction of temperature.

Sixteenth. In finding that there is no evidence that any reduction in the cost of manufacture effected by defendants' process would accrue to the public as consumers instead of the manufacturer, whereas he should have found that the evidence showed that the effect of the reduction in cost of manufacture, where the process was thrown open to competition, was to cheapen the selling price of the product to consumers.

1735 Seventeenth. In finding that it was not incumbent on complainant to show that saving in cost of manufacture did not accrue to the consumer, whereas he should have found that the complainant had failed to establish any presumption of profit by defendant- from the infringement.

Eighteenth. In finding that the defendants had realized gains and savings by reason of infringement, whereas he should have found that they had realized no gains or savings thereby.

Nineteenth. In finding that the defendants effected a saving in lime and acid, whereas he should have found that no saving was effected by the patented process.

Twentieth. In finding the amount of defendants' gains and savings to be one hundred and twenty-nine thousand four hundred and forty-one dollars and forty-seven cents ($129,441.47), whereas he should have found no profits, gains, or savings.

1736 Twenty-first. In finding that there was no evidence by which the master could ascertain the depreciation in value of fat acids obtained by the use of water alone, whereas he should have found that it was shown to be so inferior as to render the process incapable of competition with older processes.

RAMSEY, MAXWELL & MATTHEWS,
PARKINSON & PARKINSON,
Sols. and of Counsel for Defendant-.

And afterward, to wit, on the 13th day of February, in the year of our Lord one thousand eight hundred and eighty-six, an entry was made upon the journal of the court aforesaid in this cause, clothed in the following words and figures, to wit:

Decree.

Journal entry W, 301.

RICHARD A. TILGHMAN
vs.
WILLIAM PROCTOR *et al.* } In Equity. 1877.

This cause having been heard upon exceptions to the master's report, and argument, as well in behalf of complainants as of defendants, and having been considered by the court, it is now, at
1737 this February term, 1886, ordered, adjudged, and decreed that the exceptions in behalf of each party be overruled and said report confirmed and judgment entered for complainant for the amount of damages reported by the master, to wit, seventy-nine thousand five hundred and sixty-six dollars and ninety-one cents ($79,566.91), with simple interest upon the royalties from October 7th, 1884, to February 4th, 1886, added thereto, making in the aggregate eighty-three thousand two hundred and seventy-five dollars and twenty-one cents; that complainant recover his costs, to be taxed, and that execution for said damages and costs issue according to law.

And afterward, to wit, on the 1st day of April, in the year last aforesaid, an entry was made upon the journal of the court aforesaid, in this cause, clothed in words and figures as follows, to wit:

Journal Entry W, 346.

RICHARD A. TILGHMAN
vs.
WILLIAM PROCTOR *et al.* } In Equity. 1877.

1738 This day came the complainant herein, by his solicitors, and in open court prayed an appeal from the order and decree entered herein on the 13th day of February, 1886, "overruling the exceptions to the master's report and sustaining and confirming said report," which said prayer is hereby allowed and granted, and the appeal bond fixed at the sum of one thousand dollars.

And afterward, to wit, on the day and year last aforesaid, the said complainant, by his said solicitors, filed in the clerk's office of the court aforesaid, in this cause, his certain appeal bond, clothed in the following words and figures, to wit:

Appeal Bond.

In the Circuit Court of the United States in and for the Southern District of Ohio.

RICHARD A. TILGHMAN, Complainant and Appellant,
vs.
WILLIAM PROCTOR, JAMES GAMBLE, W. A. PROCTOR, JAMES GAMBLE, and GEORGE H. PROCTOR, Defendants and Appellees.

1739 Know all men by these presents that we, Richard A.

Tilghman, as principal, and Edward Tilghman and William M. Tilghman, as sureties, are held and firmly bound unto the above-named William Proctor, James Gamble, W. A. Proctor, James Gamble, and George H. Proctor in the sum of one thousand dollars, to be paid to the said William Proctor, James Gamble, W. A. Proctor, James Gamble, and George H. Proctor, or their heirs, executors, or administrators; to which payment, well and truly to be made, we bind ourselves and each of us, jointly and severally, and our and each of our heirs, executors, and administrators, firmly by these presents.

Sealed with our seals and dated this 25th day of March, A. D. one thousand eight hundred and eighty-six.

Whereas the above-named Richard A. Tilghman has appealed to the Supreme Court of the United States to reverse the final decree rendered in the above-entitled cause on the thirteenth day of February, A. D. 1886:

Now, therefore, the condition of this obligation is such that
1740 if the above-named Richard A. Tilghman shall prosecute his said appeal to effect and answer all costs if he shall fail to make good his said appeal then this obligation shall be void; otherwise the same same shall be and remain in full force and virtue.

(Signed)	RICHARD A. TILGHMAN.	[SEAL.]
(Signed)	EDWARD TILGHMAN.	[SEAL.]
(Signed)	WILLIAM M. TILGHMAN.	[SEAL.]

UNITED STATES OF AMERICA,
Eastern District of Pennsylvania, } *ss:*

Richard A. Tilghman, Edward Tilghman, and William M. Tilghman, being duly sworn, each for himself, deposes and says that he is worth the sum of ten thousand dollars, exclusive of property exempt from execution and over and above all debts and liabilities.

RICHARD A. TILGHMAN.
WILLIAM M. TILGHMAN.
EDWARD TILGHMAN.

Subscribed and sworn to before me this 25th day of March, A. D. 1886.

[L. S.] J. COOKE LONGSTREET,
United States Commissioner.

1741 The above and foregoing bond is entirely satisfactory to me.

WM. M. RAMSEY,
For Appellees.

Appeal allowed and bond approved.

GEORGE R. SAGE,
U. S. District Judge, S. D. O., Sitting as Circuit Judge.

1742 And afterward, to wit, on the day and year last aforesaid, there was issued out of the said the clerk's office of the court aforesaid, in this cause, our certain citation, directed to the said defendants in error, and which said citation, with the proceedings of

the marshal of the district aforesaid, making service of the same, endorsed thereupon, as returned by said marshal into the said clerk's office on the 8th day of April, in the year last aforesaid, is hereto attached as follows, viz:

1743 *Citation.*

THE UNITED STATES OF AMERICA, *ss:*

To William Proctor, James Gamble, W. A. Proctor, James N. Gamble, and George H. Proctor, Greeting:

Whereas Richard A. Tilghman has lately appealed to the Supreme Court of the United States from a decree lately rendered in the circuit court of the United States for the southern district of Ohio, made in favor of you, the said William Proctor and others, as aforesaid, and has filed the security required by law, you are, therefore, hereby cited to appear before the said Supreme Court, at the city of Washington, on the second Monday of October next, to do and receive what may appertain to justice to be done in the premises.

Given under my hand at the city of Cincinnati, in the sixth circuit, this first day of April, in the year of our Lord one thousand eight hundred and eighty-six.

[Seal of the Circuit Court, South. Dist. of Ohio.]

GEORGE R. SAGE,
U. S. District Judge, S. D. O., sitting and holding Circuit Court, there being no circuit judge or associate justice in said district.

1744 Service accepted for Wm. Procter, Jas. Gamble, Jas. N Gamble, & Wm. A. Procter by me.

WM. A. PROCTER.

I accept service for all of the above-named appellees and for G. H. Procter.

WM. M. RAMSEY, *Sol'r.*

Received this writ at Cincinnati, Ohio, on the 1st day of April, 1886, and on the 5th day of April, 1886, I served the within-named W. A. Proctor by delivering to him personally a true copy of this writ; and on the same day I left a true copy of this writ with the said W. A. Proctor for each of the within-named appellees, William Proctor, James Gamble, and James N. Gamble, the said W. A. Proctor accepting service for the said appellees; and on the same day service of said persons was accepted by William M. Ramsey, their solicitor; also served G. H. Proctor, within named, acknowledgment of service for said G. H. Proctor, endorsed hereon by his solicitor, Wm. M. Ramsey.

H. C. UMER, *U. S. Marshal,*
By J. KIERSTED, *Deputy.*

5 services	10 00
6 copies	3 00
2 miles	12
	$13 12

[Endorsed:] United States circuit court, S. D. O., W. D. No. 1877. Richard A. Tilghman *vs.* William Proctor *et al.* Citation to appellee. Filed —— 18—. ———, clerk. Geo. Harding, solicitor.

1745 *Clerk's Certificate.*

UNITED STATES OF AMERICA,
Western Division of the Southern District of Ohio:

I, B. R. Cowen, clerk of the circuit court of the United States within and for the division and district aforesaid, do hereby certify the foregoing to be a true and correct transcript of the record and proceedings in the cause therein named as the same remains of record and on file in this office.

In testimony whereof I have hereunto set my hand and affixed the seal of the court aforesaid, at the city of Cincinnati, in the division and district aforesaid, this the 8th day of April, A. D. 1886, and in the one hundred and tenth year of the Independence of the United States of America.

[Seal of the Circuit Court, South'n Dist. of Ohio.]

B. R. COWEN,
Clerk U. S. Circuit Court, S. D. O.,
By ROB'T C. GEORGE, *Deputy.*

1746 At a stated term of the circuit court of the United States within and for the sixth judicial circuit and the western division of the southern district of Ohio begun and held at the court-rooms in the city of Cincinnati, in the said division and district aforesaid, on the first Tuesday of February, being also the second day of that month, in the year of our Lord one thousand eight hundred and eighty-six, and in the one hundred and tenth year of the Independence of the United States of America—present, the Honorable John Baxter, circuit judge—among the proceedings had were the following, to wit:

RICHARD A. TILGHMAN, Complainant, *vs.* WILLIAM PROCTOR, JAMES GAMBLE, W. A. PROCTOR, JAMES N. GAMBLE, and GEORGE H. PROCTOR, Respondents.	No. 1877.	In Equity.

And be it remembered that after the proceedings in this cause theretofore had, as hereinbefore fully certified up to the Supreme Court of the United States, to wit, at a stated term of the said circuit court within and for the district aforesaid begun and held at
1747 said court-rooms in the said city of Cincinnati, in said division and district aforesaid, on the first Tuesday of April, being also the sixth day of that month, in the year of our Lord one thousand eight hundred and eighty-six, and of the Independence of the United States of America the one hundred and tenth, present, the Honor-

able George R. Sage, one of the judges, and on, to wit, the twenty-third day of April, in the year last aforesaid, a journal entry was made upon the journal of the court aforesaid in this cause clothed in the following words and figures, to wit:

Journal Entry, W. 380.

R. A. TILGHMAN
vs.
PROCTOR & GAMBLE. } 1877. Equity.

Now come the defendants, and pray an appeal to the Supreme Court of the United States from the order and decree of this court confirming the report of the master and awarding a judgment against the defendants, and the court grants said appeal and fixes the amount of the appeal bond at five hundred dollars ($500), said bond not to operate as a supersedeas.

If said defendants desire to supersede the said judgment the court fixes the amount of the bond for that purpose at one hundred and seventy thousand dollars ($170,000.00).

And afterward, to wit, on the 26th day of April, in the year
1748 last aforesaid, came the defendants herein aforesaid, by their solicitors, and filed in the clerk's office of the court aforesaid in this cause their certain bond for appeal, clothed in the words and figures as follows, to wit:

Appeal Bond.

Circuit Court of the United States, Southern District of Ohio, Western Division.

RICHARD A. TILGHMAN *vs.* WILLIAM PROCTOR *et al.*

Know all men by these presents that we, William Proctor, James Gamble, W. A. Proctor, James N. Gamble, and George H. Proctor, as principals, and David B. Gamble, —, are held and firmly bound unto Richard A. Tilghman in the sum of five hundred dollars, to be paid to the said Richard A. Tilghman, his heirs, executors, or administrators; to which payment, well and truly to be made, we bind ourselves and each of us, jointly and severally, and our and each of our heirs, executors, and administrators, firmly by these presents.

Sealed with our seals. Dated this 26th day of April, 1886.

Whereas the above-named William Proctor and others, as aforesaid, have taken an appeal to the Supreme Court of the United States to reverse the decree rendered in the above-entitled action by the circuit court of the United States for the southern district of Ohio:

1749 Now, therefore, the condition of this obligation is such that if the above-named William Proctor and others, as aforesaid, shall prosecute their said appeal to effect and answer all

costs if they shall fail to make good their plea, then this obligation to be void; otherwise to remain in full force and virtue.

(Signed) PROCTOR & GAMBLE. [SEAL.]
(Signed) DAVID B. GAMBLE. [SEAL.]

Sealed and delivered in presence of—
ROBT. C. GEORGI.
CHAS. W. RATTERMAN.

The above security is approved.

GEORGE R. SAGE,
District Judge of the United States, S. D. O.

(Affidavit of surety attached.)

SOUTHERN DISTRICT OF OHIO, *ss:*

I, David B. Gamble, one of the sureties above named, do solemnly swear that after paying my just debts and liabilities I am worth ten thousand dollars in real estate in my own name, situate in the county of Hamilton, in said district.

DAVID B. GAMBLE.

Sworn to before me the 26th day of April, 1886.
[L. S.] ROBT. C. GEORGI,
Dep. Clerk U. S. Circuit Court, S. D. O.

1750 And afterward, to wit, on the 28th day of April, in the year last aforesaid, came the said complainant herein aforesaid, by his said solicitors, and filed in the clerk's office of the court aforesaid in this cause his certain waiver of citation in this cause, and which said waiver of citation is hereunto attached as follows, to wit:

Waiver of Citation.

Circuit Court of the United States, Southern District of Ohio.

PROCTOR *et al. vs.* RICHARD A. TILGHMAN.

I hereby waive service of the citation to appear in the Supreme Court of the United States in the above case.

FRANCIS T. CHAMBERS,
Att'y for R. A. Tilghman.

[Endorsed:] No. 1877. U. S. circuit court, S. D. O., W. D. R. A. Tilghman *vs.* Wm. Proctor *et al.* Appearance as to citation. Filed Apr. 28, 1886. B. R. Cowen, clerk.

1751 UNITED STATES OF AMERICA,
Western Division of the Southern District of Ohio:

I, B. R. Cowen, clerk of the circuit court of the United States within and for the division and district aforesaid, do hereby certify that the foregoing is a true and correct transcript of the record and proceedings in the cause therein named in the court aforesaid, sub-

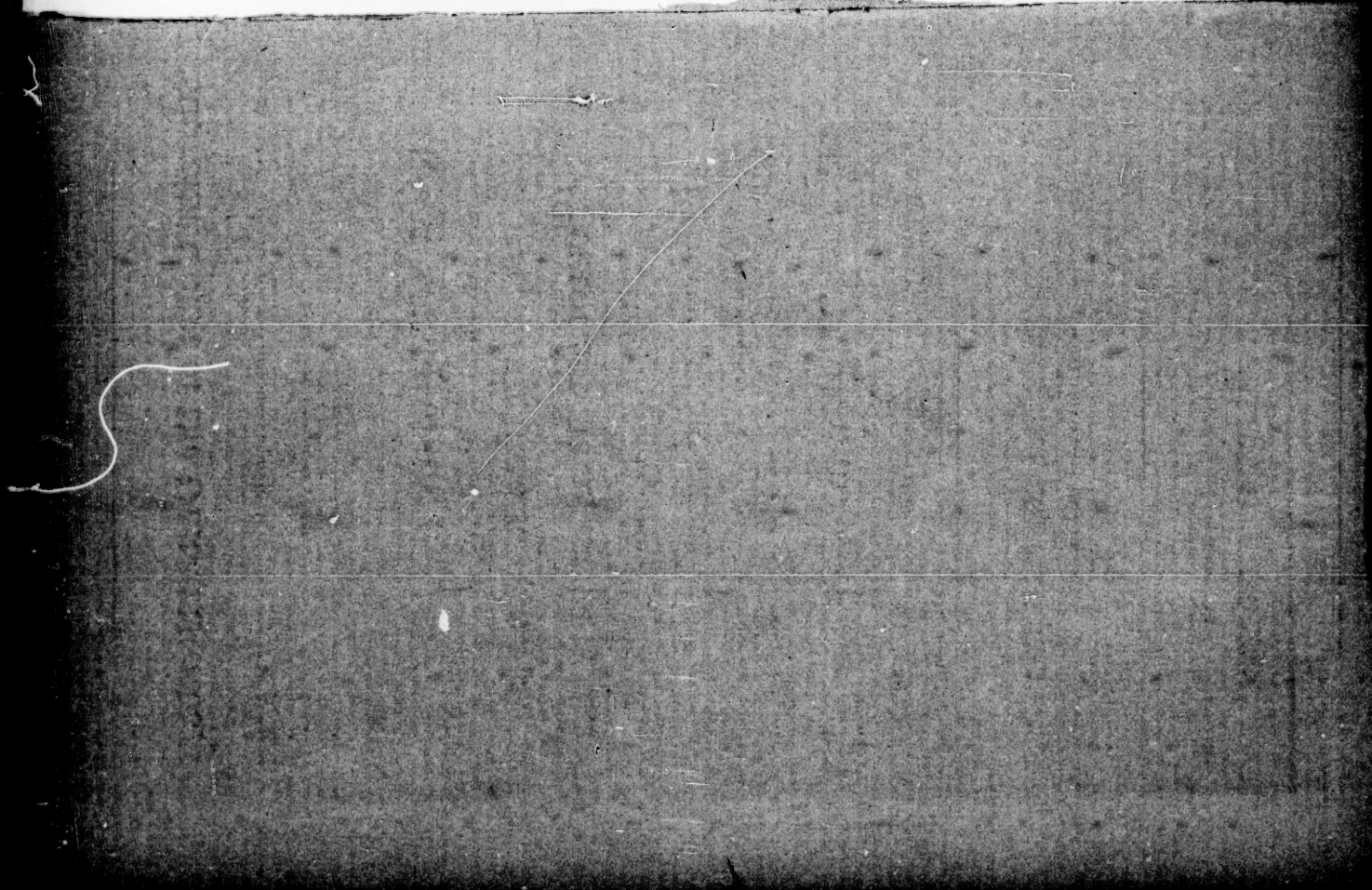
sequent to the decree therein, and pertaining particularly to the appeal of defendants therein, as the same remains of record and on file in this office.

In testimony whereof I have hereunto set my hand and affixed the seal of the court aforesaid, at the said city of Cincinnati, in said division and district aforesaid, on this the 29th day of April, A. D. 1886, and in the 110th year of the Independence of the United States of America.

[Seal of the Circuit Court, South'n Dist. of Ohio.]

B. R. COWEN,
Clerk U. S. Circuit Court, S. D. O.,
By ROB'T C. GEORGI, *Deputy.*

Endorsed on cover: S. Ohio C. C. U. S. No. 883. Richard A. Tilghman, appellant, *vs.* William Proctor, James Gamble, W. A. Proctor, James N. Gamble, and George H. Proctor. Filed April 17, 1886. No. 895. William Proctor, James Gamble, W. A. Proctor, James N. Gamble, and George H. Proctor, appellants, *vs.* Richard A. Tilghman. Filed May 3, 1886.



Supreme Court of the United States.

OCTOBER TERM, 1886.

R. A. Tilghman,
Appellant,
vs.
Proctor et al.,
Appellees.

No. 883.

Proctor et al.,
Appellants,
vs.
R. A. Tilghman,
Appellee.

No. 895.

Brief and Argument for R. A. Tilghman, the Complainant below.

GEORGE HARDING,
FRANCIS T. CHAMBERS,
Of Counsel for Tilghman.

SUPREME COURT OF THE UNITED STATES.

ON APPEAL.

Tilghman vs. *Proctor* et al.	}	No. 883.
Proctor et al. vs. *Tilghman.*	}	No. 895.

Abridged Statement of Case.

In the Circuit Court Tilghman was the plaintiff, and Proctor *et al.* the defendants.

The suit is brought for the infringement of Tilghman's patent No. 11,766 of October 3d, 1854.

The case is here for the second time, this court having decided in *Tilghman* vs. *Proctor*, 102 U. S., 707, that the patent was valid and infringed by the defendants. (For the opinion of the court as to the construction of the patent and the infringement, see *post*, pages 2 to 13.)

Pursuant to the mandate of this court a decree was made by the Circuit Court directing the defendants to account for

and pay to complainant the gains, savings, &c., accruing to them by the infringement, *post*, page 13.

The nature of the proofs before the master is briefly stated, *post*, pages 15 to 30.

The master reported the complainant's damage, based on his established license rate, as $79,566.71, and the gains and savings to the defendants as $129,441.47. His report is abstracted, *post*, pages 30 to 34.

To this report complainant filed twelve exceptions, stated in brief, *post*, pages 34 to 35, and in full, *post*, pages 38 to 42. The defendants also filed twenty exceptions.

The Circuit Court dismissed the exceptions of both parties, and entered a decree for the complainant for $83,275.21, the amount of the damages based on the license fee with interest to the date of the decree, ignoring the gains and savings (*post*, page 36).

From this decree appeals have been taken both by the plaintiff and the defendants.

Inasmuch as the court below delivered no opinion, the case comes before this court on appeal in the form of a hearing upon the master's report, and the exceptions taken to it by the plaintiff and defendants.

THE PLAINTIFF, AS APPELLANT, ASSIGNS FOR ERROR:—

First.—The action of the lower court in entering a decree for plaintiff's damages instead of for the defendant's gains and savings.

Second.—The action of the lower court in overruling the complainant's exceptions to the master's report.

Third.—The action of the lower court in not awarding to the plaintiff the amount of defendants' savings, with interest thereon.

The assignments of error are printed in full, *post*, pages 38 to 42.

SUPREME COURT OF THE UNITED STATES.

APPEALS FROM THE CIRCUIT COURT OF THE UNITED STATES FOR THE SOUTHERN DISTRICT OF OHIO.

Tilghman vs. *Proctor* et al.	No. 883.
Proctor et al. vs. *Tilghman.*	No. 895.

BRIEF AND ARGUMENT FOR R. A. TILGHMAN, THE COMPLAINANT.

Statement of the Case.

These are cross appeals from the final decree of the court below fixing the damages which the complainant, Tilghman, is entitled to recover from the defendants, Proctor *et al.*, because of their infringement of his patent No. 11,766, granted October 3d, 1854, antedated January 9th, 1854, and extended for seven years from the ninth day of January, 1868.

The case was before this court in October term, 1880, on the appeal of Tilghman from the decree of the lower court, dismissing his bill of complaint for want of equity. This de-

cree was reversed and the case remanded to the Circuit Court with directions to proceed in accordance with the opinion of this court. 102 U. S., 707.

Of the transcript of record now before the court, the first volume comprises the same matter which made up the record on the former appeal, the second volume containing the proceedings and testimony taken since the issue of the mandate from this court.

The Patent.

The complainant's patent will be found on pages 9 to 12 of the record. After announcing his discovery of the fact that fats can be decomposed into their constituent elements of fatty acids and glycerine by the action of highly heated liquid water, and describing the conditions of the operation and an apparatus suitable for carrying the process into use, the patent concludes as follows:—

> "Having now described the nature of my said invention
> "and the manner of performing the same, I hereby declare
> "that *I claim as of my invention the manufacturing of fat*
> "*acids and glycerine from fatty bodies by the action of water*
> "*at a high temperature and pressure.*"

How construed by this Court.

The construction of this claim is fully discussed in the former opinion of the court, from which the following extracts are taken as bearing directly on this question:—

> "Tilghman's discovery was made in 1853, and was, in brief,
> "this: That the fat acids can be separated from glycerine,
> "without injury to the latter, by the single and simple
> "process of subjecting the neutral fat whilst in intimate
> "mixture with water, to a high degree of heat under suf-
> "ficient pressure to prevent the water from being con-
> "verted into steam, without the employment of any alkali
> "or sulphuric acid, or other saponifying agent; the oper-
> "ation, even with the most solid fats, being capable of
> "completion in a very few minutes when the heat applied

"is equal to that of melting lead, or 612° Fahrenheit; but "requiring several hours when it is as low as 350° or "400° Fahrenheit. The only conditions are, a constant "and intimate commixture of the fat with the water, a "high degree of heat, and a pressure sufficiently power- "ful to resist the conversion of the water into steam. "The result is, a decomposition of the fatty body into its "elements of glycerine and fat acids, each element taking "up the requisite equivalent of water essential to its sep- "arate existence, and the glycerine in solution separating "itself from the fat acids by settling to the bottom when "the mixed products are allowed to stand and cool. In "this process a chemical change takes place in the fat in "consequence of the presence of the water and the active "influence of the heat and pressure upon the mixture.

"We are satisfied that Tilghman was the original discoverer "of this process." * * * * * * *

"The specification then goes on to describe, by the aid of "the drawing referred to, the particular device mentioned. "But it is evident, and indeed is expressly announced, "that the process claimed does not have reference to this "particular device, for the apparatus described was well "known, being similar to that used for producing the hot "blast and for heating water for the purpose of warming "houses." * * * * * * * *

"It is evident that the passing of the mixture of fat and "water through a heated coil of pipe standing in a fur- "nace is only one of several ways in which the process "may be applied. The patentee suggests it as what he "conceived to be the best way, apparently because the "result is produced with great rapidity and complete- "ness. But other forms of apparatus, known and in pub- "lic use at the time, can as well be employed without "changing the process. A common digester, or boiler, "can evidently be so used, provided proper means are "employed to keep up the constant admixture of the "water and fat, which is a *sine qua non* in the operation. "Tilghman himself, as we have seen, often used such di-

" gesters in making his experiments before applying for
" his patent; and, in putting up machinery for his licensees
" after his patent was obtained, he did the same thing
" when the parties desired it. Yet surely the identity of
" the process was not changed by thus changing the form
" of apparatus. No great amount of invention was re-
" quired to adapt different forms of well-known appa-
" ratus to the application of the process. The principal
" difficulty would be in providing an internal arrangement
" in the boiler, or digester, for successfully keeping up
" the intimate commixture of the fat and water. It is evi-
" dent that this could be accomplished by means of re-
" volving reels armed with buckets, or of a force pump
" constantly transferring the heavy stratum of water from
" the bottom of the mass to the top, aided by horizontal
" diaphragms partially sectionizing the digester. These
" devices were resorted to by Tilghman and others when
" they used a boiler instead of a coil of pipe.

" Whilst Tilghman in his patent recommends the high de-
" gree of heat named, he does not confine himself to that.
" It had been fully developed in his experiments, and
" was well known to him, that a lower degree of heat
" could be employed by taking longer time to perform
" the operation; and this would be necessary when boilers,
" or digesters, of considerable size were used instead of
" the coil of pipe, on account of the decreasing power of
" large vessels to resist the internal pressure. The speci-
" fication, after describing the use of a metallic coil of
" pipe, proceeds to add :—

" ' The melting point of lead has been mentioned as the
" ' proper heat to be used in this operation, because it
" ' has been found to give good results. But the change
" ' of fatty matters into fat acid and glycerine takes place
" ' with some materials (such as palm oil) at or below the
" ' melting boint of bismuth [510° Fahr.]; yet the heat
" ' has been carried considerably above the melting point
" ' of lead without any apparent injury, and the decom-
" ' posing action of the water becomes more powerful as the

"'heat is increased. By starting the apparatus at a low "'heat, and gradually increasing it, the temperature "'giving products, most suitable to the intended appli- "'cation of the fatty body employed, can easily be deter- "'mined.'

"Now, when we find it stated, as we do in this specifica- "tion, that the patentee subjects 'fatty or oily bodies to "'the action of water at a high temperature and press- "'ure, so as to cause the elements of those bodies to "'combine with water;' that 'the mixture may be "'placed in any convenient vessel in which it can be "'heated to the melting point of lead, until the operation "'is complete;' that 'the vessel must be closed and of "'great strength, so that the requisite amount of pressure "'may be applied to prevent the conversion of water into "'steam;' that 'the decomposition of the neutral fats by "'water takes place with great quickness at the proper "'heat;' that 'the melting point of lead has been men- "'tioned as the proper heat to be used in this operation, "'because it has been found to give good results;' that "'the change of fatty matters into fat acid and glycerine "'takes place with some materials at or below the melting "'point of bismuth;' that 'the decomposing action of "'water becomes more powerful as the heat is increased;' "that 'by starting the apparatus at a low heat, and grad- "'ually increasing it, the temperature giving products "'most suitable to the intended application of the fatty "'body employed, can easily be determined;'—and when "we find that the patentee categorically claims, in gen- "eral terms, as his invention, '*the manufacturing of fat* "'*acids and glycerine from fatty bodies by the action of water* "'*at a high temperature and pressure*;' and being satisfied "that he was, in fact, the inventor of the general process "described and bodied forth in the specification; how "can we, by any fair rule of construction, circumscribe "this claim in such a manner as that it shall only cover "the process when applied in the use of a coil of pipe "heated to 612° Fahrenheit? Or, if we allow it to em-

"brace any 'convenient vessel,' and do not confine it to "a coil of pipe, how can we confine it to a particular de- "gree of heat? What did Tilghman discover? And "what did he, in terms, claim by his patent? He dis- "covered that fat can be dissolved into its constituent "elements by the use of water alone under a high degree "of heat and pressure; and he patented *the process* of "'manufacturing fat acids and glycerine from fatty bod- "'ies by the action of water at a high temperature and "'pressure.' Had the process been known and used be- "fore, and not been Tilghman's invention, he could not "then have claimed anything more than the particular "apparatus described in his patent; but being the invent- "or of the process, as we are satisfied was the fact, he "was entitled to claim it in the manner he did."

* * * * * *

"Let us apply these principles to the present case. In the "first place, the claim of the patent is not for a mere "principle. The chemical principle, or scientific fact, "upon which it is founded is, that the elements of neutral "fat require to be severally united with an atomic equiv- "alent of water in order to separate from each other and "become free. This chemical fact was not discovered by "Tilghman. He only claims to have invented a particu- "lar mode of bringing about the desired chemical union "between the fatty elements and water. He does not "claim every mode of accomplishing this result. He "does not claim the lime-saponification process nor the "sulphuric-acid-distillation process, and if, as contended, "the result was accomplished by Dubrunfaut, Wilson and "Scharling, by means of steam distillation, he does not "claim that process. He only claims the process of sub- "jecting to a high degree of heat a mixture continually "kept up, of nearly equal quantities of fat and water in "a convenient vessel strong enough to resist the effort of "the mixture to convert itself into steam. This is most "certainly a process. It is clearly pointed out in the "specification, and one particular mode of applying it and

"carrying it into effect is described in detail. But it is "not the particular apparatus described which Tilghman "desires to secure by his patent. Having pointed out "the process and suggested a particular mode of apply- "ing it, he claims as his invention '*the manufacturing of "'fat acids and glycerine from fatty bodies by the action of "'water at a high temperature and pressure.*' The true "construction of this claim is to be sought by comparing "it, as we have already done, with the context of the "specification; with the statement of the patentee that "his 'invention consists of a *process* for producing free "'fat acids and solution of glycerine from those fatty and "'oily bodies of animal and vegetable origin, which con- "'tain glycerine as a base;' that 'for this purpose he "'subjects these fatty and oily bodies to the action of "'water at a high temperature and pressure, so as to "'cause the elements of those bodies to combine with "'water and thereby obtain at the same time free fat "'acids and solution of glycerine;' that he 'mixes the "'fatty body to be operated upon with from a third to a "'half of its bulk of water, and the mixture may be placed "'in any convenient vessel in which it can be heated to "'the melting point of lead' [which is afterwards ex- "plained to be only desirable for a quick result, not "essential]; that 'the vessel must be closed and of great "'strength, so that the requisite amount of pressure may "'be applied to prevent the conversion of the water into "'steam.' This is the process which the patentee claims "to have invented; and this description of it gives the "proper construction and qualification to the claim."

The Infringing Process.

Described in Answer.

The process and apparatus used by the defendant is described in their answer (Record, pages 21 and 22), as follows:—

"And the defendants represent that the process employed "by them since the said 9th day of January, 1868, is

"conducted in an apparatus and under conditions sub-
"stantially as follows, to wit :—

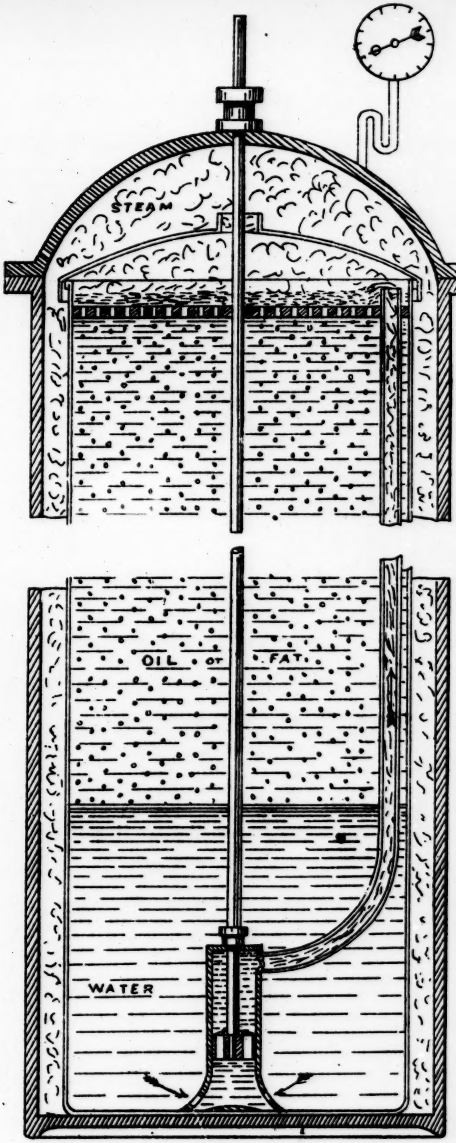
"The apparatus consists of a digester or strong iron tank of
"the dimensions of about twenty-five (25) feet in length
"and about four (4) feet internal diameter. Within said
"tank is placed a second tank, made of copper, slightly
"less—say four (4) to six (6) inches—in diameter than
"the exterior tank, the interior tank being bolted at its
"bottom to the exterior tank.

"Into the interior tank there is placed fat and water in
"equal quantities, together with lime, in quantity equal
"to one per cent. of the quantity of fat, the usual charge
"of fat being sixty-five hundred to seven thousand
"pounds, according to the quality and kind employed.

"When the fat, water, and lime have been placed in the di-
"gester or tank the digester is not full by several feet.

"Upon the introduction of the fat, water, and lime, super-
"heated steam, at a pressure of between 200 and 250
"pounds to the square inch, is introduced near the top of
"the iron tank, and finds its way through numerous
"holes left for the purpose into the interior copper tank,
"and is there brought into contact with and made to
"operate upon the contents of the interior tank during
"the time that the charge of fat remains in the tank,
"during all of which period steam in large quantities is
"necessarily and intentionally present in said tank with
"the fat; that the duration of the operation is from nine
"(9) to ten (10) hours, during which period the first
"charge of water is drawn off and a second charge of
"water, about one hour before the completion of the di-
"gestion, is introduced.

"Within the interior tank, about five (5) feet from its top, is
"placed a perforated diaphragm, and also within said in-
"terior tank is a pump, which, during the process, is con-
"stantly at work, and the function of which is to preserve
"a constant agitation and intermingling of the contained
"contents by pumping the water from the bottom to the
"top of the vessel and discharging it on the upper sur-



Proctor & Gamble's Apparatus

Drawing from Appellants brief referred to by President Morton in answer to Ques. 9 (page 254)
C Richards
Martin

" conduct
" stantial
" The appa
" the dim
" and ab
" tank is
" less—s
" the ex
" bottom
" Into the
" equal
" to one
" of fat
" pound
" When th
" gester
" Upon th
" heated
" pound
" the ir
" holes
" and i
" operat
" the ti
" durin
" neces
" the fa
" (9) t
" charg
" water
" gesti
" Within
" place
" terio
" stant
" a cor
" cont
" top c

"face of the fat in order that it, the water, may, by its "greater specific gravity, shower itself through the fat."

A drawing of this apparatus will be found opposite page 1560 of the record, and is here reproduced.

How considered by this Court.

After fixing the complainant's rights under his patent as already quoted, the opinion of this court takes up the question of the infringement, dealing with it in the same elaborate and definite manner as follows:—

"It only remains that we should express our views on the "question of infringement. The defendants advance sev- "eral reasons for the purpose of showing that their pro- "cess does not conflict with that of Tilghman."

Apparatus.

"First, because they do not use the apparatus described in "the complainant's patent; but use a boiler in which the "charge of fat and other materials is placed and heated; "and do not mix the fat and water in the manner pointed "out in the specification of the patent, but, on the con- "trary, have inserted in the boiler a pump which forces "the water as it settles to the bottom upwards to the top "of the mass and pours it upon the upper surface, whence "it again finds its way down through the fat, thus keep- "ing up a constant mixture. It is unnecessary to add "anything further on the subject of the form of the appa- "ratus used. The patentee is not confined to a metallic "coil of pipe heated in a furnace; but his patent extends "to and embraces any convenient vessel for holding the "mixture, which is strong enough to sustain the pressure "necessary to prevent the water from being converted "into steam. The defendants use such a vessel, and use "it for the purpose indicated and pointed out in the pat- "ent. The vessel which they use has the requisite strength "to prevent the water from being converted into steam, "and does effect that object. *And as to the defendants*

"*using a different method from that suggested in the pat-*
"*ent for keeping up the mixture of fat and water, that is of*
"*no consequence. The keeping up of the mixture is the im-*
"*portant thing. That is a necessary part of the process.*
"*They employ such a device for effecting this as is adapted*
"*to the form of vessel in which they heat the material.*
"Using a boiler instead of a coil of pipe, for this pur-
"pose, they are obliged to employ an additional, or modi-
"fied means for keeping up the mixture. *They only employ*
"*such means as, in view of the change adopted in the form*
"*of the heating apparatus, and of the known appliances in*
"*use in analogous processes, would naturally suggest them-*
"*selves to a mechanic skilled in the art.* Or, if the mode
"of effecting the continued mixture adopted by the de-
"fendants should be deemed a new and useful improve-
"ment, they might perhaps have a patent for that pecu-
"liar device without being entitled to use Tilghman's
"process, on which it is but an improvement."

Use of Lime.

"Another ground on which the defendants argue that they
"do not infringe the patent is, that they do not, in their
"process, use water alone in admixture with fat, but use
"also some portion of lime: that they formerly used
"seven per cent. of lime, and now use four per cent.*
"But they do not use lime in the manner and to the ex-
"tent in which it is used for dissolving fats by the sapon-
"ifying process. That requires twelve or fourteen per
"cent. *Even if the saponifying process partly takes place,*
"*they use Tilghman's process for effecting the balance of the*
"*operation. They use water in admixture with fat, heated*
"*to a high degree, far above the boiling point, and yet sub-*
"*jected to such pressure as to prevent the water from being*
"*converted into steam;* and though they may also use
"other things at the same time, which other things may
"facilitate the operation, or render a less degree of heat

* Should be *one per cent.* See answer. The Court was doubtless misled by the testimony in the record as to Werk's infringement where *four* per cent. of lime was used.

" necessary than would be required when water alone is " used, and thus actually improve the process of Tilgh- " man; yet this process is included in their operation, " and forms the basis of it. It is idle, therefore, to say " that they do not infringe Tilghman's patent. *It is un-* " *necessary to determine what precise part the lime used by* " *the defendants plays in their process; whether, as the com-* " *plainant contends, it saponifies the fat to a certain extent,* " *leaving the remainder to be acted upon by the water alone* " *purely after the process of Tilghman: or whether, as the* " *defendants contend, the lime produces a more perfect and* " *active commixture of the fat and water, or predisposes the* " *fat to unite with the requisite elements of water necessary* " *for producing glycerine and the fat acids: in either case* " *the process of Tilghman, modified or unmodified by the* " *supposed improvement, underlies the operation performed* " *in the defendants' boilers.*"

Heating by Steam.

" Another ground assumed by the defendants to avoid the " charge of infringement is, that they do not heat the " mixed mass in the manner pointed out in Tilghman's " specification; but instead of heating the containing " vessel by an outside application of heat, they heat the " contents by the introduction of super-heated steam. " But we think that this does not alter the essential char- " acter of the process. *The heating by steam is clearly an* " *equivalent method to that of heating by an external fire.* " The patent does not prescribe any particular method of " applying the heat, except when using the pipe and coil " apparatus described in the specification; and, even in " the use of this apparatus, the outward application of " the heat to the pipe is suggested incidentally and as a " matter of convenience rather than as an essential requi- " site. The patentee showed one method in which the " heat could be applied. That was all that was neces- " sary for him to do. If it could be applied in any " number of different methods, it would not affect the " validity of the patent as a patent for a process. The

"method of heating the mixture by the introduction of "steam may be attended with some beneficial results, in "producing an agitation or automatic circulation helpful "to the perfection of the admixture of the water and "fat; and so far it may be an improvement on heating "from without. Suppose this to be so, as before said, "the introduction of an improvement gives no title to "use the primary invention upon which the improvement "is based."

Temperature Used.

"Finally, the defendants argue that they only use a low "degree of heat and pressure compared with that pointed* "out by the patent, namely, only about 310° Fahrenheit "instead of 612°. *The precise degree of heat, as we have "seen, is not of the essence of the patent.* The specification "only claims that a high degree of heat, such as would "be sufficient to melt lead, is most effective and rapid in "producing the desired result; but suggests a trial of "the apparatus employed with different degrees of heat "so as to ascertain that which is best for each particular "kind of fat. 'By starting the apparatus,' the language "is, 'at a low heat, and gradually increasing it, the tem-"'perature-giving products most suitable to the intended "'application of the fatty body employed can easily be "'determined.'"

Summary.

"It is probably true, as contended for by the defendants, "that by the use of a small portion of lime, the process "can be performed with less heat than if none is used. "*It may be an improvement to use the lime for that purpose: "but the process remains substantially the same. The patent "cannot be evaded in that way.* The matter may be stated "thus:—*Tilghman discovers a process of decomposing fats "by mixing them with water and heating the mixture to a*

*This should be "about 400° Fahrenheit" as the pressure used by defendants averages about 225 pounds (see answer, page 21.) In this instance also the court was misled by the testimony in the Werk case, Mr. Collier having only reprinted for this court his old argument in the Werk case at Cincinnati, instead of preparing one on the facts of this case.

"*high temperature under a pressure that prevents the for-*
"*mation of steam. It is a new process, never known before.*
"*The defendants seeing the utility of the process, and be-*
"*lieving they can use a method somewhat similar without*
"*infringing Tilghman's patent, put a little lime into the*
"*mixture, and find that it helps the operation, and that*
"*they do not have to use so high a degree of heat as would*
"*otherwise be necessary. Still, the degree of heat required*
"*is very high, at least a hundred degrees above the boiling*
"*point; and a strong boiler, or vessel, is used in order to*
"*restrain the water from rising into steam.* CAN A BALDER
"CASE BE CONCEIVED, OF AN ATTEMPTED EVASION, AND A
"REAL INFRINGEMENT OF A PATENT?"

"And as to the low degree of heat used in the operations
"of the defendants, this must also be said: that, with
"the reduction of the temperature, the time of perfect-
"ing the operation is more than proportionally increas-
"ed. Tilghman was aware of this result, and pointed it
"out in his patent. He expressly says: 'The decompos-
"'ing action of the water becomes more powerful as the
"'heat is increased.' What can be done in minutes by
"the application of a very high degree of heat, requires
"hours to do at the temperature used by the defendant.
"But the process is still the same, and the defendants
"fail to evade the patent."

THE INTERLOCUTORY DECREE.

After the filing of the mandate of this court in the court below, the following interlocutory decree was, after argument, settled and made by his Honor, Judge Baxter. Record, page 1194.

Decree and Order of Reference.

"RICHARD TILGHMAN
"*vs.*
"WM. A. PROCTOR *et al.*
} 1877. In Equity.

"This cause coming on for further hearing, in pursuance of
"the mandate of the Supreme Court of the United States,

"it is by the court this the 16th day of February, 1882,
"ordered, adjudged, and decreed that the patent issued
"to Richard A. Tilghman on the third day of October,
"1854, and antedated as of the ninth day of January
"of that year, being letters patent No. 11,766 for a
"process of manufacturing fat acids and glycerine from
"fatty bodies, is valid, and is a patent for a process, and
"is infringed by the defendants by the use of the process
"employed by them.

"It is further ordered, adjudged, and decreed that the com-
"plainant do recover from the said defendants whatever
"profit or saving has accrued to or been effected by them
"by the use of the process covered by the said patent of
"the complainant, in accordance with the opinion of the
"Supreme Court herein, as well as any damages in ex-
"cess thereof which the complainant has sustained by
"reason of the defendants' said infringement and which
"shall seem meet upon the coming in of the master's re-
"port.

"It is further ordered, adjudged, and decreed that the
"complainant do recover of the defendants the costs and
"charges and disbursements in this suit to be taxed.

"It is further ordered, adjudged, and decreed that it be re-
"ferred to Channing Richards, Esq., as master, to ascer-
"tain and tax and state and report to the court an ac-
"count of the gains, profits, savings, and advantages
"which the said defendants have received or which have
"arisen or accrued to them from infringing the said
"exclusive rights of the said complainant by the use of
"the process patented in the said letters patent, as well as
"the damages the said complainant has sustained thereby.

"And it is further ordered, adjudged, and decreed that the
"complainant, on such accounting, have the right to
"cause an examination of said defendants, *ore tenus* or
"otherwise, and also the production of the books,
"vouchers, and documents of defendants, and that the
"said defendants attend for such purpose before said
"master from time to time as said master shall direct."

PROCEEDINGS BEFORE THE MASTER.

The above decree awards to the complainant "whatever "profit or saving has accrued to or been effected by the de- "fendants by their use of the process covered by the patent "of the complainant," and the reference to the master is to ascertain the amount of such "gains, profits, savings, or ad- "vantages."

How such *gains* or *savings* are to be ascertained in case of the infringement of a *process patent* was settled by this court in the case of Mowry *vs.* Whitney, 14 Wall., 620, where the whole subject is fully discussed, and which case has, we believe, been followed in all cases where its principles are applicable.

In this case Mr. Justice Strong, delivering the opinion of the court, states the law as follows, page 649:—

> "It is the additional advantages the defendant derived from "the process—advantages beyond what he had without "it—for which he must account."

Again, he continues, page 651:—

> "The question to be determined in this case is, what ad- "vantage did the defendant derive from using the com- "plainant's invention over what he had in using other "processes then open to the public and adequate to ena- "ble him to obtain an equally beneficial result? The "fruits of that advantage are his profits. They are "all the benefits he derived from the existence of the "Whitney invention.
>
> "It is found that there were other processes by which the "inherent strain caused by unequal cooling would be "and was corrected, counteracting which strain was the "sole object of the complainant's invention, and a car- "wheel could be prepared for similar service, valuable "in the market, and saleable at a price not less than was "obtained for those which the defendant manufactured.
>
> "The inquiry, then is, what was the advantage in cost, in "skill required, in convenience of operation, or marketa-

"bility, in bringing car wheels by Whitney's process "from the condition in which they are when taken hot "from the moulds to a perfect state, over bringing them "to the same state by those other processes, and thus "rendering them equally fit for the same service? That "advantage is the measure of profits."

The effect or result of Mr. Tilghman's process is to decompose neutral fats into fatty acids and glycerine. These same fats could have been treated by the defendants by other processes which they had a perfect right to use, and similar products obtained. The question for the master was, then, to ascertain how much the defendants had saved or gained by wrongfully using our process instead of those processes which were public, and which they had a right to use.

COMPLAINANT'S TESTIMONY.

Standard of Comparison—Best Open Process.

The defendants themselves testify that before adopting Mr. Tilghman's process they were using what is known as the "*old lime saponification process*," and the record shows that this process was in almost universal use in this and European countries. There can be no serious question but that this was, at the time of Mr. Tilghman's invention, and at the time of the infringement, the best and most economical non-infringing process known in the art. The question then is, what have the defendants saved by using the patented process rather than the old lime saponification process.

The Patented Process	*The Old Process*
Consists of the method of decomposing fats into fatty acids and glycerine by the action of water at a high temperature and pressure and in intimate admixture with the fats.	Consists of the following steps :— (*a.*) The conversion of the fats into lime soap by means of lime. (*b.*) The decomposition of the lime soap by means of sulphuric acid.

Both processes resulting in the production of (1) commercial fatty acids and (2) solution of glycerine.

Savings in Lime and Acid.

Defendants' use of lime and acid by old process.

The defendants, who for a long while used the old process in their business, were examined, and testified that, as used by them, fourteen pounds of lime and forty-two pounds of acid were used for each one hundred pounds of fat decomposed.

James Gamble, pages 586–7 ;
James Gamble, page 1217, Q. 4.

Defendants' use of lime and acid by infringing process.

During their infringement, they used, in connection with Mr. Tilghman's process, one pound of lime and three pounds of acid to get it out again.

Answer, page 21 ;
J. N. Gamble, page 1213, Q. 45 & 46.

Saving in lime and acid by infringing process.

Their saving, then, in these items over the old process as used by them, was the value of thirteen pounds of lime and thirty-nine pounds of acid for each hundred pounds of fat.

This is undisputed and indisputable.

The pecuniary value of these savings is easily ascertained from the tabular statements prepared and offered in evidence by the defendant J. N. Gamble. These are printed on pages 1501 to 1512 of the record.

The amount and value of the fat treated during each month of the infringement is shown on pages 1508 to 1511, the total amount being 23,322,777 pounds.

The cost of acid during this period is shown on pages 1501 to 1506.

The cost of lime during the same time, on page 1512.

In the following tables we show the exact amount of these two items of the defendants' gain :—

Savings in Lime.

YEAR.	Pounds of Fat worked.	Lime saved; 13 per cent. of Fat worked. Lbs.	Value of Lime at 35 26-100 cts. per 100 lbs. (Gamble, p. 17.)	Interest up to December 31, 1883.	
				Years.	Amount.
1870, from May 10, ...	2,273,699	295,580	$1,042 21	13	$812 92
1871, ...	4,142,434	538,516	1,898 80	12	1,367 13
1872, ...	4,884,091	634,931	2,238 76	11	1,477 58
1873, ...	5,411,229	703,459	2,480 39	10	1,488 23
1874, ...	6,436,974	836,806	2,950 57	9	1,593 30
1875, to Jan. 5, ...	174,350	22,665	79 91	8 yrs. 1 2/3 mos.	43 02
	23,322,777	3,031,957	$10,690 54		$6,782 18

Saving in Sulphuric Acid.

YEAR.	Fat worked. lbs.	Acid saved, 39 per cent. lbs.	Price per lb. cts.	Value of Acid saved.	Total of year.	Interest to Dec. 31, 1883.	
						Year.	Amount.
1870, May 10 to Dec. 31, .	2,273,699	886,742	3¼	$28,819 11	28,819 11	13	$22,478 90
1871, to Jan. 5, ...	50,595	19,732	3¼	641 29			
To May 22, ...	1,694,978	660,924	3	19,827 72			
" Sept. 18, ...	992,978	387,261	2¾	10,649 67			
" Dec. 4, ...	1,062,834	414,505	2½	10,362 62			
" Dec. 31, ...	341,349	133,126	2¼	2,995 33	44,476 63	12	32,023 17
1872, Aug. 20, ...	1,383,546	539,572	2¼	12,140 37			
To Dec. 31, ...	3,500,505	1,365,396	2	26,303 92	38,444 29	11	25,373 23
1873, March 16, ...	1,357,026	529,240	2	10,584 80			
To April 8, ...	387,329	150,958	2⅛	3,207 85			
". Aug. 22, ...	1,574,292	613,973	2½	15,349 32			
" Sept. 5, ...	197,214	76,913	2¾	2,115 10			
" Nov. 18, ...	1,123,022	437,978	3	13,139 34			
" Dec. 31, ...	772,346	301,214	2¾	8,283 38	52,679 79	10	31,607 87
1874, to Aug. 12, ...	3,450,436	1,345,670	2¾	37,005 92			
To Oct. 13, ...	1,288,158	502,381	2½	12,559 52			
" Dec. 11, ...	1,222,145	476,636	2¼	10,724 31			
" Dec. 31, ...	376,275	146,747	2	2,934 94	63,224 69	9	34,141 33
1875, to Jan. 9, ...	274,310	106,980	2	2,139 60	2,139 60	8 yrs. 11 2/3 mos.	1,151 81
					$229,784 11		$146,776 31

These two items of lime and acid may be called the *chemical* savings, as they are the direct result of Mr. Tilghman's *chemical* discovery, and the fact of his discovery being established, it would seem that there could be no question but that these savings were directly and solely due to the use of his process.

Glycerine.

Besides the saving in lime and acid it is not disputed but that defendants have by the infringing process produced glycerine water of much greater value than they could have produced by the use of the old process.

To show the value of this gain the complainants relied on the following evidence:—

Quantity, density, and value of defendants' glycerine.

We have, in the first place, the quantity, density, and value of the glycerine water made and sold by the defendants under the infringing process. The quantity is shown in the Exhibit Glycerine Statement, (page 1507) to be 65.312 barrels, and Mr. Gamble in his testimony on page 1212, Q. 33, states the average density of the glycerine water as it came from the digesters to be 3¼° Baumé. See also for the number of pounds in a barrel of this glycerine water (Gamble, page 1215, Q. 67) where Mr. Gamble states that each barrel contained about 330 pounds.

65,312 barrels × 330 = 21,552,960 pounds.

We have, therefore, 21,552,960 pounds of glycerine, of a density of 3¼° Baumé, produced from 23,322,777 pounds of fat (see fat statement), showing that the glycerine water produced by the defendants was substantially equal in bulk to the fat treated by them, or in exact figures, 92.4 per cent. of it.

Quantity and density of old process glycerine.

The quantity and density of the glycerine water produced by the old process, is established as follows:—

(*a.*) *Quantity.*

Mr. William A. Proctor, one of the defendants, and who was a member of the firm while they were using the old process, testified on pages 1225 and 1226 of the record, that the saponifying tubs were *half filled with fat*, and then water was poured into the tubs until they were *nearly full;* room, however, being left for the ebullition of the water during the boiling of the charge.

(See Proctor, page 1226, Qs. 65 and 66.)

From this it follows that the amount of glycerine water in the vats at the end of the treatment was *less* in bulk than the fat used; but a great deal of this glycerine water was, of course, soaked into and entangled in the mass of lime soap, and could not be run off and separated from this mass (see Proctor, page 1225, continuation of answer to Q. 51).

Under these circumstances an estimate of the amount of glycerine water as equalling ninety per cent. of the fat used, would seem to be very liberal, but for convenience in calculation, it will be best to estimate it as bearing the same ratio to the fat as does the glycerine of the defendants' infringing process, to wit: 92.4 per cent.

(*b.*) *Density.*

The density of this old process glycerine is established as follows:—

Mr. Florence Verdin, who was a partner of R. G. Mitchell, testified (page 180 of the Record, Q. 7) that his firm, while using the old lime saponification process, used about the same quantity of water and an apparatus of the same character as that used by the defendants; and Mr. J. T. Verdin, a nephew of F. Verdin, and a chemist who had grown up in the business, testified (Record, page 164, × Q. 152) that the density of this glycerine solution was from about ½° Baumé to 1° Baumé.

What defendants would have got if working by old process.

It is then clear that if the defendants had used the old process for decomposing fat during the period of their infringe-

ment, they would have produced at the best an *equal quantity* of glycerine water, to wit: 65,312 barrels, but of a density averaging but ¾° Baumé, instead of 3¼° Baumé.

Comparative quantity of glycerine by old and new processes.

This is best ascertained by showing how many barrels of glycerine at 3¼° could be derived from the 65,312 barrels of glycerine at ¾°, and by referring to Mr. J. N. Gamble's testimony we have the facts as to four tests, showing the relation between the density and the quantity of water:—

First.—on page 1216, Q. 71, he states that it required 6½ barrels of a density of either 3° or 3¼°, to make one barrel of a density of 15°; that is, while the ratios of the densities was as 1 to 4.61, the shrinkage in actual bulk or quantity was from 6.50 to 1.

On page 1236, Q. 93, he gives the result of three other tests, showing the following results:—

Second.—One barrel of 3° or 3¼° density made but 33.53 pounds of 25° density. Now a barrel contains 330 pounds (Gamble, page 1215, Q. 67), so that we have the ratios of the densities as 1 to 7.69, while the concentration was from 9.83 to 1.

Third.—13.73 barrels of $3\frac{9}{10}$° he says made 1 barrel of 20°, from which we have a ratio of the densities as 1 to 5.13 while the concentration was from 13.73 to 1.

Fourth.—He says 1400 gallons of $3\frac{9}{10}$° gave 294 gallons of 16°, from which we have a ratio of the density of 1 to 4.10, while the concentration was from 4.76 to 1.

From the above data the master calculates correctly that it would require $4\frac{4}{5}$ barrels of a density of ¾° to make one of 3° (see his report, page 1200).

But for the sake of simplicity we will assume that the old process glycerine water contained glycerine in proportion to its density, then we have

Glycerine by infringing process 3¼° = $\frac{13}{4}$

Glycerine by old process, ¾° = ¾

and hence it would take four and one-third (4⅓) barrels of the old process glycerine to make one of such glycerine as was

made and sold by the defendants, or in other words to bring the old process glycerine to the same density as that of the infringing process it would be necessary to evaporate three and one-third (3⅓) out of every four and one-third (4⅓) barrels.

Therefore from the 65,312 barrels of ¾° which defendants would have obtained if working by the old process they would have had to evaporate 50,240 barrels of water out of it to bring the remaining solution to a density of 3¼°, and they would then have obtained but 15,072 barrels of glycerine of this density instead of the 65,312 which they actually got by the infringing process. And instead of receiving $103,143.03 they would have received but $23,702.23. The difference, $79,440.80, is evidently clear gain from the use of the infringing process.

Cost of Concentration.

As shown above, in order to obtain the 15,072 barrels of merchantable glycerine of 3¼° the defendants would have had to evaporate 50,240 barrels of water from the old process glycerine in concentrating it. This of course would have been an item of considerable expense, and as to this cost we have the following evidence:—

It appears that the defendants sold their glycerine just as it came from the digesters, having a density indicated by 3¼° B., but they concentrate this glycerine after the sale to a density of 15° B., charging the customer the *exact cost* to them of the process of concentration, which was $1.55 per barrel of 15° glycerine.

(Gamble, page 1212, Q. 34; page 1216, Q. 71; pages 1234 and 1235, Q. 90.)

And Mr. Gamble also testifies that it took 6½ barrels of crude glycerine to make one barrel of 15° Baume.

(Gamble, page 1216, Q. 71.)

From this it appears that *the cost* to the defendants of evaporating 5½ barrels of water was $1.55 or *$0.2818 per barrel.*

To evaporate the 50,240 barrels of surplus water, which they would have had to get rid of had they used the old pro-

cess, would have cost the defendants 50,240 × $.2818 = $14,157.64, which subtracted from the sum, $23,702.23, which the glycerine would have been worth after concentration, leaves $23,702.23 — $14,157.64 = $9,644.60 as the total real value of the 65,312 barrels of old process glycerine.

The difference between this sum and the cash actually received by defendants for their glycerine, $103,143.03—$9,644.60 = $93,498.43, is the gain which defendants have made in the item of glycerine from their use of the patented process.

In the following table this calculation is worked out in detail :—

Gain in Glycerine.

	Value—By Defts. process.		Value—By old Lime Saponification.								
	A	B	C	D	E	F	G	H	I	K	
YEARS.	Bbls. Glyc. water of 3¼° B produced.	Value Received.	Bbls. of Glyc. water of 0.¾°B obtainable.	Bbls. of Glyc. water at 3¼°, B contained in C, being 3-13 of C.	Gross value of D, at same price per bbl. as B, 3-13 of B.	Bbls. of water to be evaporated to convert C into D, 10-13 of C.	Cost of evaporating F at 28 18-100 cts. per bbl.	Net value of Glyc. at 3¼ B produced, being the difference between F and G.	Saving on Glycerine, being the difference between B and H.	Interest at 6 per cent. up to Dec. 31, 1883.	
										No. of Years.	Amount of Interest.
1870,	8,041	$7,534 60	8,041	1,856	$1,738 75	6,185	$1,742 93	Nil.	$7,534 60	13	$5,876 98
1871,	14,966	15,973 38	14,966	3,454	3,686 16	11,512	3,244 08	$442 08	15,531 30	12	11,182 53
1872,	13,702	22,265 68	13,702	3,162	5,138 22	10,540	2,970 17	2,168 05	20,097 63	11	13,264 43
1873,	14,062	23,586 84	14,062	3,245	5,443 11	10,817	3,048 23	2,394 88	21,191 96	10	12,715 17
1874, to Jan. 8, 1875,	14,541	33,782 53	14,541	3,355	7,795 95	11,186	3,152 21	4,643 74	29,138 79	9	15,734 94
	65,312	$103,143 02		15,072	$23,802 19	50,240	$14,157 62		$93,494 28		$58,674 05

Complainant's calculation favorable to defendants.

This calculation is much more favorable to the defendant than proven facts warrant, for it leaves out of consideration a number of facts which would, if considered, probably demonstrate that they could have got nothing for their glycerine had it been made by the old process; among these the following may be mentioned :—

First.—In assuming that the density of ¾° Baume in the old process solution was entirely due to glycerine present, we leave out of consideration the fact that it must have been, to a large degree, due to the presence of soluble lime salts; for, where fourteen per cent. of lime was used, all the soluble acids in the fat will take up their full equivalents of lime, though where but one per cent. is used, they are but partly neutralized.

Second.—In considering that the amount of glycerine water from the old process was equal in bulk to the amount which the defendants actually obtained, we are more favorable to the defendants than the fact warrants.

Third.—It is perfectly evident that the process of concentrating glycerine results in a large loss of glycerine. This is evident from Mr. Gamble's statement, that it takes six and one-half barrels of a density of 3¼° to make one barrel of a density of 15°.

In our calculation, however, we have assumed that no glycerine was lost in concentrating it to 3¼°.

Saving of Fat.

In the old process, as these defendants used it, lime equal to fourteen per cent. of the fat was used to form a lime soap and afterwards precipitated by means of acid. The sulphate of lime thus formed was precipitated in the tank, where it formed a thick mud for about a third of its height. In this mud a large quantity of fat acids was most intimately entangled. The only way of separating and saving this fat was by repeated boiling and stirring, so as to give the little drops or particles of oil a chance to disentangle themselves and rise to the surface, where they were skimmed off and saved.

The total yield of fat acids by the old process after saving all that could be saved from the sulphate of lime is stated to be ninety-five pounds to each one hundred pounds of fats treated.

J. Gamble, page 1218, Q. 16;
N. Ropes, Jr., page 570, Q. 20;
J. C. Verdin, page 164, Q. 153.

From a test made for the purpose, Mr. Ropes found the yield from the patented water process, using one-half per cent. of lime, to be ninety-seven per cent.

Ropes, pages 570, 2–21.

And Mr. Verdin states, page 403, Q. 26, also pages 444 × Q. 27, that a saving of two per cent. was effected by using the water process instead of the old lime process.

The evidence of Ropes and Verdin is that of adverse critics. Ropes was, when he made the test, experimenting to ascertain the value of the new process before purchasing the right to use it, and Verdin was a partner of Mitchell, the defendant in the suit, in which his testimony was given.

Their evidence is confirmed by the papers called "Context of Defendants' Exhibit, No. 2," printed page 1553, where it is stated that in a public experiment with the water process, Cloetz obtained 97.5 per cent. of fat acid of the most excellent quality.

The rest of the testimony on this point is that of parties directly interested in this suit, and therefore not entitled to so much weight.

Mr. Proctor (page 1220, Q. 16) says that more than twenty-five years ago, while learning the business, then (1850 to 1858) employing only the old process, he made a series of trials and got from 95 to 97 per cent., according to the cleanness of the stock. The records of these trials were destroyed twenty years ago. At page 1229, Q. 94, he weakens and says that the yield was *about* 95 per cent., the 97 per cent. yields being exceptional. It will be noted that he disagrees with his senior partner, J. Gamble, who says they always calculated on 95 per cent. (page 1218 Q. 16.)

Mr. J. N. Gamble describes (page 1344, Q. 23) a trial made in July, 1882, upon 69,960 pounds of prime tallow in their digesters with one per cent. lime. He got a yield of only 94.36 per cent., which is 0.64 per cent. less than the recognized yield by the old lime saponification.

This shows at once that this trial is not reliable. There is no place where a loss can occur except in the sulphate of lime, which is thrown away after being washed. All the other

products are collected and worked up, and Mr. Gamble obtained 365 pounds of fat acid (0.52 per cent. of the fat treated) by the concentration of the glycerine water which would have been thrown away in their old process. The material used was prime tallow and it was well decomposed, and according to Mr. Proctor's statement ought to have yielded 97 per cent. by the old lime process.

On the other side we have B. C. Tilghman (page 1247, Q. 5), who says that laboratory tests made prior to 1859 gave about the same results as Ropes, and R. A. Tilghman (page 1242, Q. 6) who after Proctor's testimony made the test of treating a sample of the old process sulphate of lime four times by boiling with acid, ten or fifteen times with calcareous sand and acid, and three times with boiling alcohol, and found that after all this it still contained some fat acids.

This, if true, conclusively proved that it is practically impossible to extract all the fat, and *no attempt was made to rebut it.*

On the basis of the above testimony it would seem that the defendants using 1 per cent. of lime instead of 14 per cent. could save $\frac{13}{14}$ of 2 per cent. of the fat = to 1.857 per cent. of all the fat treated. The value of this saving being $34,121.72, as is shown in the following table :—

Savings on Fat.

	A	B	C	Interest account up to December 31, 1883.	
YEAR.	Lbs. of fat worked.	Value of fat worked.	Value of fat saved 13-14 of 2 per cent. of B=.01857.	Years.	Amount.
1870 .	2,273,699	$198,358 09	$3,683 70	13	$2,873 28
1871, .	4,142,434	340,469 00	6,322 51	12	4,552 20
1872, .	4,884,091	394,705 23	7,329 67	11	4,837 58
1873, .	5,411,229	393,239 76	7,302 46	10	4,381 47
1874, .	6,436,974	487,609 28	9,054 09	9	4,889 64
1875, .	174,350	23,074 48	428 48	8 yrs. 11⅔ mos.	230 66
	23,322,777	$1,837,455 84	$34,121 72		$21,767 83

Saving in Cost of Working.

The record shows that the digester process is much cheaper than the old lime saponification process in the items of labor and fuel.

(*a.*) *As to Labor.*

Mr. F. Verdin, testifies (Rec., page 403) that for each 8000 pounds of fat decomposed by the old process a day's labor of five men was required; a day's labor of one man was therefore required to decompose 1600 pounds of fat.

Mr. J. N. Gamble, testifies (Rec., page 1344) that using the infringing process, his firm decomposed 33 digesters of 6500 pounds each or 214,500 pounds per week, using the labor of only four men; this is equal to a day's labor for one man for each 8940 pounds of fat decomposed. The infringing process thus enabled them to obtain 5½ times the amount of decomposed fat obtainable from the same amount of labor by the old process.

Mr. Gamble's testimony, on page 1344, was given with the idea of showing the digester process in the best light, as against what he was pleased to call the complainant's process. When before the master we referred to it in the above connection, his counsel claimed that there were really two shifts of four men employed, a statement which is certainly not warranted by the testimony, but which is very probably true. On this basis, then, we would have a day's labor of one man equal to 4470 pounds of fat, and the infringing process would be in labor but 2¾ times better than the old process.

(*b.*) *As to Fuel.*

Mr. F. Verdin (Rec., page 403), testifies that to decompose 8000 pounds of fat by the old process required one ton of coal, or 280 pounds of coal per thousand pounds of fat worked.

Mr. J. N. Gamble (page 1466), testifies that by the infringing process each operation in a digester required (averaging his figures) 1358 pounds of coal to a charge of 6750 pounds of fat, or 200 pounds of coal per thousand pounds of fat

decomposed. This is only $\frac{7}{10}$ as much coal as that required by the old process.

WHAT COMPLAINANT REQUESTED THE MASTER TO REPORT.

On the basis of the above evidence, the complainant requested the master to report specifically the following facts:—

First.—That the gains, savings, and advantages for which the defendants must account according to the decree, are the gains, savings, or advantages which inured to them by reason of their use of the patented process instead of the lime saponification process.

Second.—That by reason of their use of complainant's patented process, the defendants have saved the value of 13 pounds of lime for each 100 pounds of fat decomposed.

Third.—That the pecuniary value of the lime saved is $10,690.54.

Fourth.—That by reason of their use of complainant's process, the defendants have saved the value of 39 pounds of sulphuric acid for each 100 pounds of fat decomposed.

Fifth.—That the pecuniary value of the sulphuric acid saved is $229,784.11.

Sixth.—That by reason of their use of complainant's process, the defendants have obtained stronger and purer glycerine water.

Seventh.—That the increased value of the glycerine by reason of its strength alone, exceeds the value of the glycerine obtainable by the old process by $93,494.28.

Eighth.—That by reason of their use of the complainant's process, the defendants have saved a net loss of fat treated, and which was thrown away in the old process.

Ninth.—That the value of this saving is $34,121.72.

Tenth.—That by reason of their use of complainant's process the defendants have saved the wages of eighteen men for each full day's work.

Eleventh.—That by reason of their use of complainant's process defendants have saved a considerable quantity of coal.

Twelfth.—The amount of the accrued interest on the sums for which the defendants must account.

DEFENDANTS' TESTIMONY.

In one sense practically all of the evidence in the account may be said to be that of the defendants. Every fact which complainant requested the master to report is established either by the evidence of the defendants themselves or of witnesses called by them.

There is, and can be, no question but that the amount of gains and savings which we requested the master to find in the items of lime, acid, and amount of glycerine, were actually pocketed by the defendants by reason of their use of the infringing process rather than their old lime saponification process.

That defendants also saved the expense of concentrating the old process glycerine from a density of 3/4° to a density of 3 1/4° cannot be disputed, but as to this defendants argue that the evidence on which we rely is not sufficient to make out the fact that each barrel of water necessarily evaporated would cost $.2818.

That there is in the old process a necessary loss of fat acids is clear, and that by the water process there can be no loss is beyond question. But here again defendants question the sufficiency of our process to make out the pecuniary value of this saving.

That the infringing process is in labor and fuel cheaper than the old process is of course beyond question.

But the defendants claim that the infringing process embodies modifications of the patented process in its use of one per cent. of lime and of a double dose of water, and that for any increase in the savings due to these alleged modifications they are not to account; and they undertook to prove that water alone would not effect a practically useful decomposition of fat—that a little lime was essential to a practical use of the process—and therefore that the whole of the savings were due to this "modification."

In aid of this proposition the defendants constructed a coil apparatus, which they claimed to have built and operated in way described by Mr. Tilghman in his patent, and through

their so-called "experts" they made a number of other experiments as to the chemical power of water upon fats.

The above contention will be fully discussed by us in our argument in support of our exceptions to the master's report and in this statement it is only necessary to note that the plaintiff claims to have demonstrated that it is absolutely baseless by facts and admissions *drawn from the defendants' own witnesses* and has not found it necessary or worth while to call a single witness in rebuttal.

One other point which defendants sought strenuously to establish was that fats could be decomposed by distillation with superheated steam, and that this so-called steam-distillation process was of greater economy than the old lime process, and therefore a more fitting standard of comparison. Before, however, this branch of their case was fully developed it was abandoned, their own witnesses confessing that the pretended facts on which it was based were false.

This curious affair we will also have occasion to discuss in the argumentative part of our brief.

THE MASTER'S REPORT.

The report of the Master will be found on pages 1196 to 1206 of the record, and may be briefly analyzed as follows:—

1.

He finds that the complainant did not manufacture, but exercised his rights under the patent by granting licenses at a substantially uniform rate of twenty cents per hundred pounds of fat treated, and that the complainant's damage is the amount of this license rate with interest, amounting to $79,566.71 on October 7th, 1884.

2.

He finds that the old lime saponification process was more advantageous than any other *open to public use* during the infringement.

3.

He finds:—

(*a.*) That by the old process the average amount of lime

and acid used by manufacturers was: of lime 13 pounds, of acid 32½ pounds.

(*b.*) That in their use of the infringing process defendants used but 1 pound of lime and 3 pounds of acid.

(*c.*) That they have therefore saved 12 pounds of lime and 29½ pounds of acid for each 100 pounds of fat, amounting for the 23,322,777 pounds of fat treated to

2,798,733 pounds of lime at $0.3536 per hundred, ...	$9,868 33
6,880,219 pounds of acid at $2.527 per hundred, ...	173,863 13
Total saving in chemicals, . . .	*$183,731 46

4.

He finds:—

(*a.*) That the evidence is not sufficient to enable him to find that two per cent. of the fat, or any *certain* quantity, was lost in the old process and saved by the new process.

(*b.*) That there is no material economy in the cost (fuel, labor, wear and tear, &c.) of running the new apparatus rather than the old apparatus.

5.

He finds:—

(*a.*) That the glycerine water of the old process had a density of only ¾°, while by the infringing process the defendants got a solution of 3¼°, density.

(*b.*) That the concentration of defendants' solution from 3¼° to 15° cost $1.55 per barrel at respondent's factory, and that on the assumption that the cost of concentration will be in like proportion for each degree, the cost of concentrating the old process glycerine would be about $.94 per barrel of 3⅓°; but for reasons given he does not think the evidence suf-

*The master makes an error in his addition, giving the total as $182,731.46, and this error is continued through all of his calculations.

ficient to enable him to make any finding as to the cost of concentration, and he therefore gives complainant no credit on this account.

(*c.*) That the glycerine water of the old process was double in quantity the glycerine water of the infringing process, and that only defendants' first charge of water was sold by them as glycerine.

(*d.*) That defendants' total gain in glycerine was $61,701.77.

6.

He finds:—

(*a.*) That the value of fatty acids for the manufacture of candles depends largely upon their purity, and therefore the practical value of any system of decomposing fats depends largely upon the completeness of the result, because there is, in case of an incomplete decomposition, first, a corresponding loss of fatty acids; second, an admixture of undecomposed fats, decreasing the value of the product.

(*b.*) That evidence as to the practicability of the water process pure and simple in the coil, or Wright & Fouché apparatus, is too remote to be considered.

(*c.*) That the evidence does not show that water alone was ever regularly used in such digesters as those of the defendants, and that several of complainant's licensees tried to do so without success, and found it necessary to use a little lime.

(*d.*) That introducing the water into the digesters in two doses was an advantage.

(*e.*) That defendants using their digesters at a pressure of 225 pounds, and with the modifications of the use of one per cent. of lime and water in two doses, "both "of which are shown by the evidence to be efficient," obtained a good quality of fatty acids "though not "fully equal to that obtained by lime saponification."

(*f.*) That the advantage derived by defendants from the "modifications" of the process are not involved in this suit.

(*g.*) Here (page 1202) the master gives a list of what he called unsuccessful attempts by manufacturers to decompose fats in digesters by water alone, compiled by him from the old parts of the record, and states that such testimony is uncontradicted and indeed corroborated by *all* the evidence in point, and he finds in conclusion "that the fatty acid product obtained by respondents operating in their digesters "for nine and a-half hours at an average pressure of "225 pounds, by the action of water alone was inferior "in value to the product of lime saponification."*

(*h.*) That the experiments made pending the hearing before the master at 225 pounds with water alone in defendants' digesters yielded products containing *an average* of 92.5 per cent. of fatty acids, while experiments at lower pressure showed products still more inferior.

(*i.*) That, as compared with the results of lime saponification, the experiments at 225 pounds with water alone and in one dose show a *loss* of 6 pounds of fatty acids for each 100 pounds of fat treated, *and* an admixture of undecomposed fats seriously affecting the value of the product, and that the value of fatty acids was at least 9 cents per pound, and hence the *direct loss* of fatty acids not less than 54 cents upon each hundred pounds of fats treated.

(*j.*) That by reason of defendants' use of one per cent. of lime, 2,028,024 pounds of fat were converted into lime soap by the action of the lime, 21,294,753 pounds of fat were converted into fatty acid mixture, containing 92.5 per cent. of free fatty acids, by the action of the water, the further decomposition of such mixture being effected by modifications of complainant's process.

---

*We give this finding in the master's words, and as, in view of the fact that defendants never did operate with "water alone," it is obscure, we suggest that the master intended to state what would have been the fact *if* they had so operated.

7.

He finds the net gains and savings as follows:—

Amount saved in chemicals, ...	$182,731 46
Amount gained in glycerine, ...	61,701 77
Total, ...	244,433 23
Deducting loss of fatty acids, being 54 cents per hundred on 21,294,753 lbs. of fat, ...	114,991 76
Net gains and savings, ...	$129,441 47

8.

He finds that the circumstances of the case are not such as entitle the complainants to interest on the savings.

COMPLAINANT'S EXCEPTIONS.

The exceptions taken by the complainant to the master's report are printed, record, pages 1561 to 1563, and are reprinted in full in our assignment of errors, *infra*, pages 38-42 In brief they allege that the master erred.

First.

In computing the chemical saving on an alleged average use of lime and acid in the old process by others instead of on the proportions actually used by the defendants.

Second.

In reporting that there was no material economy in the operation of the infringing process.

Third.

In reporting that the evidence was not sufficient to show the cost of concentrating glycerine from ¾° to 3¼.

Fourth.

In reporting that the glycerine sold by respondents was the product of the first charge of water only.

Fifth.

In reporting that the evidence as to decomposition by water alone by Mitchell was not to be considered.

Sixth.

In reporting that decomposition by water alone had never been regularly used in such apparatus of defendants.

Seventh.

In reporting that the defendants' product was inferior to the product of the old process.

Eighth.

In reporting that the use of lime and of the device of a double dose of water were efficient modifications of complainant's process.

Ninth.

In reporting that the tests with water alone at 225 pounds pressure in defendants' digesters produced results inferior to the old process.

Tenth.

In reporting that any deductions should be made from defendants' actual gains and savings, by reason of the alleged modifications.

Eleventh.

In reporting the net gain and savings as $129,441.44 instead of $333,968.73.

Twelfth.

In reporting that the circumstances of the case did not justify an allowance of interest on the amount of net gains and savings.

RESPONDENTS' EXCEPTIONS.

The exceptions of the defendants are printed.' (Record, pages 1563 to 1565.) They are twenty in number, and so all embracing as to enable any question imaginable to be argued under them. The first charges that there was no

license fee. The second excepts to interest on the license fee. The fourth charges that complainant has no right to sue or recover. The fifth excepts to any finding of gains or savings, and the rest, we believe, are but modifications of the following propositions:—

First.—That water decomposition is impracticable without the use of a little lime.

Second.—That the measure of the efficiency of the complainant's process is to be judged by the efficiency of the coil apparatus described and disclaimed in his patent.

Third.—That the coil wont work practically.

Fourth.—That it is to be assumed that the public derived all the benefit of the improvement in processes.

THE FINAL DECREE.

The case was argued on exceptions before the late Judge Baxter, who, after holding it for about a year, made the following decree:—

"RICHARD A. TILGHMAN
"*vs.*
"WILLIAM PROCTOR *et al.*
} In Equity. 1877.

"This cause having been heard upon exceptions to the "master's report, and argument, as well in behalf of com- "plainants as of defendants, and having been considered "by the court, it is now, at this February term, 1886, "ordered, adjudged, and decreed that the exceptions in "behalf of each party be overruled and said report con- "firmed and judgment entered for complainant for the "amount of damages reported by the master, to wit, "seventy-nine thousand five hundred and sixty-six dol- "lars and ninety-one cents ($79,566.91), with simple in- "terest upon the royalties from October 7th, 1884, to "February 4th, 1886, added thereto, making in the ag- "gregate eighty-three thousand two hundred and seventy- "five dollars and twenty-one cents; that complainant

"recover his costs, to be taxed, and that execution for "said damages and costs issue according to law."

The court gave no opinion, and the decree is in very evident conflict with the decree and order of reference printed *ante*, page 1566, and while it purports to confirm the master's report, it in fact revokes the reference. Very clearly this decree has no reference to the exceptions of either party, and is based solely on the judgment of the court that a patentee can have no recovery in excess of an established royalty and interest thereon.

THE APPEAL.

The complainant immediately appealed from the above decree, caused the record to be certified to this court, and moved the advancement of the hearing on the ground that the case had before been before this court on the merits.

Shortly afterwards the defendants also took an appeal.

Assignments of Error.

I.

The court below erred in directing judgment to be entered for the complainant for the amount of the license fee and interest only, whereas the learned court should have directed judgment for the full amount of the gains and savings accruing to the defendants by reason of their infringement.

II.

The court below erred in refusing to allow the following exceptions taken by complainant to the Master's report, whereas the learned court should have allowed the same: —

FIRST EXCEPTION.—For that the learned Master erred in reporting the amount of the saving in chemicals by computing the said savings on the alleged average amounts of lime and acid employed in the old process by different manufacturers.

Whereas, He should have reported that the defendants while manufacturing under the old lime saponification process used fourteen pounds of lime to each hundred pounds of fat and three pounds of acid to each pound of lime; and should have computed the saving to them by reason of their infringement at thirteen pounds of lime and thirty-nine pounds of acid for each hundred pounds of fat, giving for the total quantity of fat treated during the infringement:

3,031,957 pounds of lime at $.3526 per hundred, ...	$10,690.54
9,095,948 pounds of acid at $2.526 per hundred, ...	229,784.11
Total saving of chemicals, . .	$240,474.65

SECOND EXCEPTION.—For that the learned Master erred in reporting that no material economy in operation was secured by the defendants' change of process.

Whereas, He should have reported that large savings inured to the defendants in the amount of product, the labor required, and in fuel, by reason of their use of the patented process.

THIRD EXCEPTION.—For that the learned Master erred in reporting that there was no testimony establishing the cost of concentrating glycerine water of a density of ¾° B. to a density of 3° to 3¼° B., and in reporting that the complainant was not entitled to recover the amount saved to respondents by reason of the greater strength of their crude glycerine water.

Whereas, He should have reported that the testimony showed the cost of concentrating glycerine water of ¾° to a density of 3° or 3¼°, was not less than $.9493 to $1.07 per barrel of 3° or 3¼°, and that this amount had inured to the respondents as savings from their use of the patented process, amounting in all to at least $14,570.75.

FOURTH EXCEPTION.—For that the learned Master erred in reporting that the glycerine water sold by the respondents was the product of the first charge only of the water used by the respondents in their infringing process, and was equal to but half the weight of the fat, and that in consequence the glycerine water of the old process was double the quantity of that sold by them during the infringement.

Whereas, The Master should have reported that the evidence showed that the glycerine water sold by respondents was practically equal in weight to the fat used and certainly as great in bulk as the glycerine water produced by the old process. Applying this correction to the Master's "Table B," page 1206, the amount of gain by digesters, exclusive of cost of evaporation, should

be $82,422.40, instead of $61,701.77, as reported by him in said table.

FIFTH EXCEPTION.—For that the learned Master erred in reporting that the operation and product of Mitchell's apparatus was not material to this case.

Whereas, He should have reported that Mitchell carried on the complainant's process in an apparatus substantially similar to that used by respondents; the two forms of apparatus being at the date of complainant's patent well-known mechanical equivalents for effecting an admixture of fluids.

SIXTH EXCEPTION.—For that the learned Master erred in reporting that saponification of fats by water alone has never been regularly employed by any one in such digesters as the respondents used.

Whereas, He should have reported that Mitchell, in a substantially similar apparatus, never used anything but water and produced the best decomposition of any manufacturer in the country.

SEVENTH EXCEPTION.—For that the learned Master erred in reporting that the product of the process as used by respondents was inferior in quality and value to the product of the old lime saponification process.

Whereas, He should have reported that while the comparative quality and value of the fat acids produced by lime saponification are not proved; there is every reason to believe that they were notably inferior to those of the fatty acids of respondents' infringing process.

EIGHTH EXCEPTION.—For that the learned Master erred in reporting that the alleged modifications of the patented process used by respondents, viz., the use of one per cent. of lime and a double dose of water are both shown to be efficient.

Whereas, He should have reported that the said use of lime was shown by the evidence to be not only useless but harmful, and the use of the water in two doses to be unnecessary.

NINTH EXCEPTION.—For that the learned Master erred in reporting that the evidence showed that the respondents operating their digesters with water alone, for nine and a half hours, at a pressure of 225 pounds, obtaine fatty acids inferior to those obtained by lime saponification.

Whereas, He should have reported that the result of the experiment made by the respondents showed that with water alone applied in a single dose equal to the quantity used by the respondents in the infringing process, and heated to a pressure of 225 pounds, practically perfectly decomposed fatty acids were produced in eight and a half hours.

TENTH EXCEPTION.—For that the learned Master erred in reporting that any deduction should be made from the amount of the saving in chemicals accruing to respondents for the alleged modifications on complainant's process used by respondents.

Whereas, He should have reported that the savings in chemicals accruing to respondents were entirely and solely due to their use of complainant's process.

ELEVENTH EXCEPTION.—For that the learned Master erred in reporting the amount of the gains and savings accruing to respondents from the use of complainants' process as $129,441.47.

Whereas, He should have reported the net gains and savings accruing to respondents from their infringement as

from glycerine at least,	$93,494 28
Saving in chemicals,	240,474 65
Total,	$333,968 93

TWELFTH EXCEPTION.—For that the learned Master erred in reporting that the circumstances of this case are not such as to entitle the complainant to interest on the amount of savings found to have accrued to respondents by reason of their infringement.

Whereas, He should have reported that the circumstances of this case are such as to render the allowance of interest on said savings eminently proper and advisable.

III.

The court below erred in refusing to enter a judgment for the complainant for the amount of the gains and savings affected by defendants, to wit, $333,968.93, together with interest thereon from the date when such gains and savings accrued.

Argument for Complainant as Appellant.

MEASURE OF DEFENDANT'S LIABILITY.

Conflict between interlocutory and final decrees.

The final decree in this case awards to the complainant only damages, measured by the established royalty which he was accustomed to receive from those who occupied contractual relations with him.

It can only be *reconciled* with the interlocutory decree which directs the payment to complainant of "whatever "profit or saving has accrued to or been effected by the de- "fendant by the use of the process * * * as well as any "damages *in excess* thereof," on the assumption that the damage to complainant was greater than the defendants' profits; but as the master reported profits in excess of the damages, and the court in its final decree overruled all of the defendants' exceptions, it is evident that the decrees cannot be reconciled, and that it was the intention of the court to set aside and vacate the interlocutory decree.

Lower court really decided that damages only can be recovered.

In fact, while the court below did not see fit to give any reasons for its action, there can be no question but that it acted on the principle that a patentee's recovery in equity must not be in excess of his damages as measured in an action of trespass.

Accounting for profits the settled practice in equity—Act of 1870.

That an accounting for profits as ordered in the interlocutory decree is the proper mode of ascertaining an infringer's liability in equity can hardly be questioned.

Up to the passage of the act of 1870 (Rev. Stat., section 4921),* a court of equity could make no other decree, and certainly it was neither the intent or the meaning of the act to interfere with the power of the court to grant equitable relief. From the wording of the statute it might indeed be argued that Congress intended to provide an additional protection for the intellectual property of inventors by superimposing upon the equitable relief of an account for profits, the penalty of damages, and that the concluding part of the section, authorizing the chancellor to increase the actual damages, strongly supported this construction.

We only refer to this act now, however, as showing that the uniform practice of courts of equity in ordering an account for profits in infringement cases was not only unquestioned, and their power to do so unimpaired, but that on the contrary, this practice was expressly approved by Congress in language having almost, if not quite, the force of a mandatory direction to decree the profits to the patentee.

That in view of the uniform practice of the courts, thus sanctioned by Congress, this court will adopt the view on which the decree of the court below is based, and rule that a patentee's damage as measured in an action of trespass for infringement is the maximum of the recovery which a court of equity will decree against an infringer, we cannot assume, for so great a change in the settled law would be a legislative rather than a judicial act.

Since then this is a suit in equity, the interlocutory decree

---

*SECTION 4921. The several courts vested with jurisdiction of cases arising under the patent laws shall have power to grant injunctions according to the course and principles of courts of equity, to prevent the violation of any right secured by patent, on such terms as the court may deem reasonable; and upon a decree being rendered in any such case for an infringement, the complainant shall be entitled to recover, in addition to the profits to be accounted for by the defendant, the damages the complainant has sustained thereby; and the court shall assess the same or cause the same to be assessed under his direction. And the court shall have the same power to increase such damages, in its discretion, as is given to increase the damages found by verdicts in actions in the nature of actions of trespass upon the case.

was correct, and the defendants must account to us for their gains and profits; the account is a necessary concomitant to the jurisdiction, and the jurisdiction of equity in this case has never been questioned.

Nor, were it a debatable question, could it be raised at this time, after this court had entertained the case and finally passed upon all questions except that of this account.

Principles of the equitable rule.

The equitable rule for the assessment of damages has its roots, first, in the principle that the wrongdoer should not profit by his wrong, and, second, in tenderness to the wrongdoer, since it takes from him only that which he has dishonestly acquired. This rule is not only just and reasonable, but it is necessary for the public interest. As is pointed out by Mr. Justice Swayne, speaking for this court in the case of *Rubber Co.* vs. *Goodyear, 9 Wall, 804,* where the patent in suit was for a new article of manufacture :—

> " * * 'The profits made in violation of the rights of the
> " 'complainants,' in this class of cases, within the naming
> " of the law, are to be computed and ascertained by find-
> " ing the difference between cost and yield. * * * *
> " *The rule is founded on reason and justice; it compensates*
> " *one party and punishes the other: it makes the wrong-*
> " *doer liable for actual, not possible gains. The controlling*
> " *consideration is that he shall not profit by his wrong.*
> " A MORE FAVORABLE RULE WOULD OFFER A PREMIUM
> " TO DISHONESTY AND INVITE TO AGGRESSION."

The circumstances of this infringement to which we will shortly call the attention of the court, most forcibly illustrate the truth of what the court then said as to the necessity of the rule and the mischief which would be caused by a milder one.

The defendants and the court below take the view that tenderness to the wrongdoer is the controlling principle of the equitable rule, and that while the chancellor would say to the wronged patentee, that no matter how great his damage, he could have in equity *only* the profit or advantage actually accruing to the infringer, in spite of the fact that

such profits might be absurdly small owing to unskillful management, he would on the other hand abrogate the rule and hold the patentee to a rigid proof of his damages if it appeared that the infringer derived more profit out of the invention than its owner. In short, that while the court would not take into consideration the fact that the complainant was a successful competing manufacturer, and attempt indirectly to make him whole as a manufacturer, it would if he were an unsuccessful manufacturer or a mere patent owner abrogate the equitable rule in favor of the defendant. Surely this cannot be so. If the question, whether the patentee was himself a manufacturer working under his patent, cannot be regarded in one case in favor of a plaintiff, it cannot be regarded in another against a plaintiff.

The rule uniform and firmly established.

But the question as to whether gains and profits are the rule of recovery is not now to be settled. It has long been the settled practice of the courts, not only in this country but in England, and has been adopted and enforced by this Court in every case that has been before it, and so far from holding that the measure of accountability was different where a patentee worked under his patent and where he did not, the court has repeatedly and uniformly given to owners exercising their rights by granting licenses the same uniform and certain relief that it affords to manufacturers.

Among the cases which establish the equitable rule of accountability, and to which we wish especially to refer, are:—

Mowry vs. *Whitney*, 14 Wall., 620,

which is especially in point, since the patent there mentioned was, like Mr. Tilghman's, for a process, and because the rules which govern the accounting in cases where the infringement consists of the use of a process, are very carefully explained. It is in exact accordance with these rules that we have proved our claim.

Mevs vs. *Conover*, 11 O. G., 1111.

In this case, which is a decision of this Court, the doctrine of *Mowry* vs. *Whitney* is applied to a case where the use of the

whole mechanism of which the patented device formed a part was shown to be unprofitable. Mr. Justice Strong states the law, as follows :—

"* * In the ascertainment of profits made by an infringer "of a patented invention, the rule is a plain one. The "profits are not all he made in the business in which he "used the invention, but they are the worth of the an- "vantage he obtained by such use—or, in other words, "they are the fruits of that advantage. *Mowry* vs. *Whitney*, "14 Wall, 651. We are not convinced that the rule de- "clared in that case was not followed in this. The patented "invention infringed by the defendant was a new and im- "proved machine for splitting kindling wood, and a dis- "tinguishing feature of it, perhaps the principal feature, "was a device for the automatic feeding of the wood to "the reciprocating splitting knives or cutters, by a mov- "able platform or apron carried forward by an endless "chain. That device the defendant used, though it is "said he used it in another machine, known as Green's. "The evidence is full and uncontradicted that an advan- "tage is gained in splitting kindling wood by a machine "with that device of at least seventy-five cents a cord over "splitting it by hand or without that device. It was in "harmony with this evidence the Master reported and "the Court decreed.

"It is urged, however, that the Green machine, in which "the defendant used the plaintiff's invention, was old and "defective, and that no profits were actually received from "such an use. But if such be the fact, if the defendant "was a loser by splitting wood with the Green machine, "his loss was less to the extent of seventy-five cents on "each cord split, then it would have been had he not used "the patented invention. Such a result was equivalent "to an equal gain, and it was rightly estimated as a part "of the profits for which the infringer was responsible."

The same point was decided in the same way in the cases on *The Cawood Patent*, 4 Otto, 695 (see pages 709 and 710).

In *Birdsall* vs. *Coolidge*, 3 Otto, 69, where the question before the court was the measure of damages in a suit at law, Mr. Justice Clifford, referring to suits in equity for patent infringements, says:—

"Damages of a compensatory character may also be allowed "to a complainant suing in equity, in certain cases where "the gains and savings made by the respondents are "clearly not sufficient to compensate the complainant for "the injury sustained by the unlawful violation of the ex- "clusive rights secured to him by the patent. *Gains and "profits are still the proper measure of damages in equity "suits, except in cases where the injury sustained by the in- "fringement is plainly greater than the aggregate of what "was made by the respondent,* in which event the provis- "ion is that the complainant 'shall be entitled to recover, "'*in addition to the profits* to be accounted for by the re- "'spondent, the damages he has sustained thereby.'"

In the cases on the Cawood patent the invention was of such a nature that it could only be enjoyed by granting licenses, yet this court not only applied the equitable rules, but held the defendant accountable for the savings as measured by the relative economy of the patented method and the next best method open to them, in spite of proof that the defendants had derived no actual benefit from their infringement.

These cases, with the exception of Mevs *vs.* Conover, are, together with the other leading cases in this court and in the English Court of Chancery, reviewed in the opinion delivered by Mr. Justice Matthews in *Root* vs. *Railway Co., 105 U. S., 189*, where in conclusion it is stated, (pages 214 and 215):—

"It is true that it is declared in those cases that, in suits in "equity for relief against infringements of patents, the "patentee, succeeding in establishing his right, is en- "titled to an account of the profits realized by the in- "fringer, and that the rule for ascertaining the amount of "such profits is that of treating the infringer as though "he were a trustee for the patentee, in respect to profits.

* * * * * * * * * *

"All that was meant in the opinions referred to was to de-
"clare according to what rule of computation and meas-
"urement the compensation of a complainant would be
"ascertained in a court of equity.

* * * * * * * * * *

"The rule adopted was that which the court in fact applies
"in cases of trustees who have committed breaches of
"trust by an unlawful use of the trust property for their
"own advantage; that is, to require them to refund the
"amount of profit which they have actually realized.

* * * * * * * * * *

"And the particular rule was formulated, as will be seen by
"reference to the cases already referred to, out of tender-
"ness to defendants in order to mitigate the severity of
"the punishment to which they might be subjected in an
"action at law for damages, and because it was thought
"more equitable merely to deprive them of the actual
"profits arising from their wrong, than to make no al-
"lowances, in estimating damages, for the cost and ex-
"pense of the business in the prosecution of which they
"had violated the rights of the complainant.

* * * * * * * * * *

"The rule itself is reasonable and just, though sometimes
"perverted and abused. *It has been constantly acted*
"*upon by the courts.*"

The defendants cite this case as though it ruled that the consideration of tenderness to the defendants was the dominating, the all-controlling, principle of the equitable rule, and that it was only necessary for it to appear that an infringer was likely to pay more for the theft of an invention than honest men had paid for the right to use it legally, to cause the court to set aside their uniform rule and adopt a measure of damages which would put a premium upon dishonesty. But such is assuredly not the true meaning of the opinion, and nothing could be clearer than its finding that the equitable rule was a fixed and certain incident of equitable jurisdiction.

That in referring to the fact that the equitable rule had at

times been abused the court did not have reference to its application in such cases as the present is clear from the fact that in *Thomson* vs. *Wooster, 114 U. S., 104*, decided by this court since Root *vs.* Railway Company, the facts as to the inventor's mode of exercising his rights were the same as in this case.

The patent was for a folding guide as a device for folding certain classes of goods. It appeared by the master's report (page 106) that the infringer had saved, by using the infringing machine, three cents on each piece of six yards folded by him, this gain being ascertained by comparing the actual cost with the cost of the most advantageous method open to legal use by the infringer, and amounting to $6089.35, which the master reported as the profits.

That during the period of the infringement the complainant depended upon license fees for his compensation for the use of his patent, and that according to the established license rate the defendants would have paid, if they had been licensed, the sum of $1350, which the master reported as the damages. And it also seems (see page 107) that during the infringement folded strips were an article of merchandise, cut and folded by different parties at a charge of twenty-five cents for one hundred and forty-four yards.

The court below overruled the defendant's exceptions and made a decree in favor of the complainants for the profits, disallowing the damages (see page 108), and this decree was confirmed here on appeal, Mr. Justice Bradley, in delivering the opinion of the court, saying:—

> "The second objection to the report is, that the master, in "estimating the profits chargeable to the defendants, did "not take into account the fact that folded strips, such "as those used by the defendants, were an article of mer- "chandise, cut and folded by different parties at a charge "of only twenty-five cents for one hundred and forty-four "yards. To this objection it may be observed, that the "evidence before the master did not show by what pro- "cess such folded strips were made, nor whether they

"were not really made by infringing the complainant's "patent. As the proof stood before the master, they "must have been made by the use of the complainant's ma- "chine, for there was no other known machine by which "they could have been made at any such cost. And if "made by the use of complainant's machine, the inference "must be that the persons making them were infringing "the complainant's patent, for they are not named in the "list of those to whom the complainant had granted li- "censes, which list was presented before the master at "the defendants' request. If made by such infringement "they can hardly be set up against the complainant to "reduce the amount of profits made by the defendants. "There is something singular about this part of the case. "If folded strips, suitable for the defendant's purpose, "could have been procured in the market by them at "such a low price as is pretended, why did they not pro- "cure them in that way after being enjoined against "using the complainant's machine, instead of making "them by the disadvantageous method of using a single "folder and folding one edge at a time? Was it from a "knowledge of the fact that the persons who folded such "strips were infringing the complainant's patent, and a "consequent unwillingness to become further compli- "cated in such infringements? At all events, since the "defendants chose to make their own folded strips in "their own factory, instead of going outside to purchase "them, or have them made by others, they cannot justly "complain of being accountable for the profits realized "in using the complainant's machine for that purpose. "It might have been a better financial operation to have "bought of others, or employed others to make the fold- "ed strips which they required, just as, in the case of the "Cawood patent, the railroad company would have done "better not to have mended the ends of their battered "rails, but to have had them cut off; but as they chose "to perform the operation they became responsible to "the patentee for the advantage derived from using his

"machine. Cawood Patent, 94 U. S., 695, 710. We do "not think that the objection is well taken."*

And in the recent case of *Birdsell* vs. *Shaliol, 112 U. S., 485*, Mr. Justice Gray, who delivered the opinion, quotes and adopts the language of Vice-Chancellor Wood in the case of *Penn* vs. *Bibby, L.R. 3 Eq., 308.*

In this case, after the decision of the court in favor of the patentee, the defendant through his counsel offered to pay to the plaintiff the same royalties paid by others, or to pay them into court pending the appeal. The plaintiff's counsel refused, stating that the plaintiff would not accept from a litigant the same royalties that others paid, and that it was contrary to the practice in patent matters that he should do so. It was in this connection that the Vice-Chancellor used the language quoted by Judge Gray, and which was as follows:—

"As to the royalties, I cannot compel the plaintiff to ac-
"cept the same royalty from these defendants as he re-
"ceives from others. I cannot in the decree do less than
"give the plaintiff his full right and I cannot bargain for
"him what he may choose, or may not choose, to do."

In view of these cases it can scarcely be argued that this court has ever been in doubt as to the application of the equitable rule to cases like the present, or that there is any

* Appellant's brief in this case embodies exactly the same points urged here for the defendants. On page 30½, after reciting the case of Wooster *vs.* Taylor, 14 Blatch., 487, counsel says:—

"In that case as in this one, the damage, if any, to the complainant, "was the loss of his royalty; and the *profit* to the defendant was "merely the saving of that royalty. That saving when *proved clearly* "is the measure of profits. The gain or advantage to defendant "should be thus measured, and not by comparing the double guide "wirh hand work.

"It was open to defendants to buy a license at established rates; by "refusing to do so, they saved or gained the price of that license, "and that was their sole profit. At law, such gain would be "termed damages, in equity it would be termed profits, in essence "they were identical—they differ only in respect to the terms applied "on different sides of the court. Where there is wickedness in the "infringement, the court can, on motion, increase the damages and "thus compensate complainant for expenses beyond taxable costs."

warrant for the contention that a chancellor will relieve an infringer from the consequence of his wrong, and make a contract with him in behalf of the patentee, by which he will be placed in the same position as a licensee, nay, in a better position, for he will have had the use of the money which the licensee would have paid to the patentee.

Among the Circuit Court cases which have not been appealed to this court, are *Williams* vs. *R. R. Co., 18 Blatch., 181*, and *Knox* vs. *Mining Co., 6 Sawyer, 430*, in both of which cases the complainant was shown to have derived his profits entirely from license fees; yet in both cases the court, Judge Blatchford in the one case, and Judge Sawyer in the other, held the infringer liable for the full amount of his gains or profits. In no case has the court sitting in equity refused to hold the defendant accountable for his profits or intimated any doubt but that this accountability is the fixed rule in equity.

To the same effect see *Wooster* vs. *Taylor*, 14 Blatch., 403, where Judge Wheeler had before him the same patent and the same question as to profits and damages as was before this court in Thomson *vs.* Wooster, and when his decree for profits was the same as that confirmed here.

Alleged severity of equitable rule as applied to this case.

Defendants in their argument below have attempted to support their assault upon the equitable rule as to an infringer's accountability, by trying to make out that the rule bore upon them with especial hardship.

Pretense that defendants have not received profits (a) *immaterial*, (b) *unfounded.*

First, they argued that it was to be judicially presumed that the result of Mr. Tilghman's discovery was to reduce the price of fatty acids to the extent of the saving in their cost of manufacture which his invention effected, and that, therefore, the benefit of the invention was derived solely by the public, and did not inure to the manufacturer as a profit. Under the law as explained in the Cawood cases, in Thomson *vs.* Wooster, and in Mevs *vs.* Conover, this would make no difference in the

defendants' liability, even if proved; but it would be hard on the defendants, and in pressing this in connection with their law point counsel doubtless had in mind the proverbial fact that "hard cases make bad law."

But there is not the faintest justification in the record for the assertion that the introduction of the water process effected any change in selling prices. It was certainly not incumbent on the complainant to prove that it did not, after he had proved the saving and gain which the infringer derived, and if we had attempted to follow the fat acids into the subsequent stages of their treatment and institute an inquiry as to the defendants' profits from the sale of soaps and candles, the defendants would have bitterly and successfully resisted. If, however, there were any facts which would justify counsel's assumption of a fall in price, it can hardly be doubted that defendants would have proved them. One thing we know, that is, that the old process glycerine was practically valueless. Even the small quantities that were used prior to 1854, and which were sold at four dollars a pound, were not made from the manufacturers' refuse water, but by a slow and expensive process which practically destroyed and wasted the fatty acids (see Shoemaker, pages 1236, &c.)

Mr. Tilghman practically created glycerine as an article of manufacture and every cent of the hundred thousand dollars the defendants got for their glycerine they owed to his invention.

For the rest, large as the savings of lime and acid may seem in the aggregate, they are but a small percentage on the business done, and would affect but slightly the cost of candles and soap, which were the things sold by defendants. It clearly appears that the patented process and the old lime process, and even processes less advantageous than it, were for many years used simultaneously by competing manufacturers, which would certainly indicate that the price of the products was not altered and that the whole value of the invention was secured by those who were wise enough to employ it, while, on the other hand, there is absolutely nothing to indicate the contrary.

PRETENSE THAT DEFENDANTS WERE EXCUSABLY AND HONESTLY MISTAKEN.

Second.—It is argued for the defendants that the complainant's patent was of very questionable validity, that although finally established, even this Court had, in Mitchell *vs.* Tilghman, been of the opinion that it could not be sustained, and therefore they say these defendants should be treated with especial tenderness, as being not willful and conscious wrongdoers but simply acting on a mistaken conviction as to a matter in which mistake was most natural and excusable. As counsel have heretofore presented this point it would almost seem as though they justified the infringement on the ground that it was a consequence of the mistaken decision of this Court in Mitchell *vs.* Tilghman.

Infringement four years before Mitchell case, and when five judges had sustained the patent.

But in truth this infringement began more than four years before Mitchell and Tilghman was decided, and so far from having a judicial mistake to excuse their action, these defendants deliberately cancelled their license and began their infringement in flat defiance of four decisions in favor of the patentee and not a single one against it.

It will hardly be argued that these infringers acted with prevision of the conclusions to be announced by Mr. Justice Clifford four years afterwards and were therefore to be excused for their disregard of all the decisions previously made by Justices Nelson and McLean, Mr. Justice Blatchford, then on the district bench, Judge Emmons and Judge Leavitt.

The true history of the infringement.

But fortunately it is not necessary in this case to speculate as to the reasons which might have influenced the defendants' conduct. We have their own graphic description, a perfect word picture, of the influences which dominated their action, and we have *the influence* itself in evidence.

To enable the Court to fully appreciate the defendants' conduct, we must, however, ask it to first go back for a moment to what preceded the infringement.

Defendants originally infringers.

These defendants, when they first commenced the use of Mr. Tilghman's patented process, did so as infringers; they were sued for their infringement, and after the suit was brought, settled with the complainant and took a license from him.

(See Mr. Gamble's testimony, Record, page 1209, Q. 10–13; also bill of complaint, Record, page 3.)

Defendants' apparatus erected by claimant after settlement of first suit.

As appears in the above cited testimony, Mr. Tilghman, after the settlement of this suit, designed and erected for these defendants the very apparatus in which they subsequently carried on their infringement; they having, at that time, sought and obtained a license from him to carry on the process on payment of a royalty.

Defendants took new license under extended term.

The defendants worked under the conplainant's license during the remainder of the term of the original patent, and upon its extension, they took a new license under it; and they continued to work as Mr. Tilghman's licensees and to pay him royalty, up to the tenth day of May, 1870.

Cancellation of license.

At that date they notified Mr. Tilghman that they should no longer pay him royalty and their contract was accordingly, and by consent of both parties, cancelled.

(See correspondence, Record, pages 14 and 15.)

Complainants' grounds for suspecting conspiracy.

During all of this time a most bitter and persistent war against Mr. Tilghman's patent had been carried on by a number of large infringers, and the complainant had reason to suppose that these infringers had not confined their opposition to him in the courts, but had sought to injure him by inducing other manufacturers, who were paying him royalty, to discontinue such payment, and join them in their efforts to break the patent.

Complainant alleges conspiracy in bill.

Accordingly, in his bill of complaint against these defendants, complainant especially charged and directly interrogated the defendants as to their having confederated with *Michael Werk* or some other of the prominent infringers to oppose his patent, and they were directly interrogated as to whether or not *any writing* to this effect had been signed, and by whom. Record, pages 4 and 7.

The passages in the bill referred to are as follows :—

"But now so it is, may it please your Honors, that the said "William Proctor, James Gamble, W. A. Proctor, James "N. Gamble and George H. Proctor have actually com- "bined and confederated with the said *Michael Werk*, "Thomas Kirby, John Kirby, M. Schwartz, George Shil- "lito and Roland G. Mitchell, or some of them, to resist, "embarrass and destroy the exclusive privileges secured "to your orator as aforesaid, and to use the said patented "process without license of your orator, and in violation "of his rights, and the said confederates, or some of "them, including the defendant, have held meetings and "entered into agreements and contributed, or promised "to contribute, money for the purpose last aforesaid, "hoping to embarrass and oppress your orator by pro- "tracted and expensive litigation, so as to prevent your "orator from enjoying his just rights aforesaid, and ob- "tain the use of the said patented process without pay- "ing a compensation therefor, all which is contrary to "equity and good conscience, and in contravention of "your orator's just rights in the premises."

Specific interrogatory as to conspiracy, &c. page 7, Int. 16.

"Whether or no the said defendants or either of them and "which have entered into any agreement, or has had any "agreement with the said *Werk* or F. Kirby or J. Kirby "or Schwartz or Shillito or Mitchell, or any and what "other person or persons, to contribute any and what sum "of money, or other thing of value, for the purpose of "opposing the rights of your orator under the said letters

"patent, or *paying the expenses of lawsuits*, or any and "what other expenses incurred or to be incurred, in re- "sisting the said rights under the said letters patent, and "whether any and how many meetings have been held or "consultations had, and by and between whom, and when "and where, and *whether any writing has been signed*, "and by whom, and what were its contents, and in whose "possession is the original paper?"

Specific denial of any combination, &c., with Werk or others in answer.

In their answer the defendants replied to this interrogatory, as follows (page 24):—

"And further answering, the defendants deny all combina- "tion and confederation on their part with the parties, or "any of them named in said bill of complaint, to injure "the said complainant, or to obstruct his rights in the "premises, or to obtain the use of his said patented pro- "cess without compensation to him, or to embarrass, "hinder, oppress, or injure him in any manner, and that "*the defendants have never entered into any agreement with* "*any person, or contributed money for such purpose as* "*charged in said bill of complaint.*"

Conspiracy with Werk fully proved.

Contrary to this explicit *denial under oath*, we have proved the fact of the conspiracy charged in the bill, and have in evidence the written contract in which it was embodied, and the testimony of the defendant Proctor, as to the circumstances and inducements which led them to break their contract and deliberately infringe the complainant's patent.

This contract is printed on pages 1513 and 1514 of the Record, and the circumstances attending its execution are explained by Mr. Proctor on pages 1230 and 1231.

No abstract can do justice to this testimony, and we therefore print it in full.

Cross-examination by Mr. Parkinson:—

" ×Q. 98. What advice, if any, had you obtained as to the " validity of the Tilghman patent, or as to whether it " covered the method of manufacture used by you before " you stopped paying royalty.

" A. Mr. Collier was out here and expressed himself to me " as very sanguine of defeating Mr. Tilghman, and that " he would gain Mr. Werk's case for him, and that " Mitchell would also gain his case. Mr. Collier repre- " sented to me that they had some new evidence, strong, " and that he felt very sanguine that he would be able to " defeat Mr. Tilghman. After seeing him two or three " times, incidentally meeting him one day, he invited me " to call and see him at his room in the Burnet House. " I did so, and there he urged the point that he was very " sanguine and sure of gaining the case, and said we were " foolish to continue to pay royalty, that he would be " willing to defend us for what we would pay Mr. Tilgh- " man in one year, leaving four or five years unpaid, that " is, I mean escape the payment of four or five years, the " balance of the life of the patent.

" *I said we were getting along amicably, and I did not care* " *very much for war*, but certainly if he thought that way, " it was worth consideration.

" He said, ' *Well, if you will pay me five thousand dollars, I will* " ' *guarantee that you shall not have to pay Mr. Tilghman* " ' *anything upon this patent.*'

" I said to him then, ' *Suppose we do not succeed, we will* " ' *then have to pay him.*'

" ' Well,' he says, ' I WILL GUARANTEE IF WE DO NOT UPSET " ' HIS PATENT, ALL YOU WILL BE REQUIRED TO PAY HIM IS " ' WHAT YOU WOULD PAY UNDER THE LICENSE WITH INTER- " ' EST.'

" ' Well,' says I, ' Charlie, what is *your* guarantee worth ? '

" ' Well,' says he, ' that is a pretty square sort of question.'

" I says, ' It is, but it is business.'

" Well, he thought a little while and says, ' *If I get Michael* " ' *Werk to go security, will that be satisfactory to you ?* '

"I says, '*It will.*'

"He says, 'All right.'

"I says, 'I will propose it to my partners,' and did so.

"I think he was going away at that time; I do not recollect just now, but the result was that he brought me this paper that has been offered in evidence, and *Mr. Werk had signed it*, but Mr. Collier had put in a little more than Mr. Werk wanted, putting in something about his own patent; he seemed very fond of it, something that he did not want to ignore, and they erased that much; so we accepted the paper, and the result was that the case within a year* was decided in the Mitchell case and we had the issue in the District Court dismissed; I do not know whether you call it a dismissal or not, and we paid Mr. Collier his five thousand dollars less the retainer fee.

"×Q. 99. What, if any, information had you at the time about the character of the evidence as to the invalidity of the Tilghman invention that had been introduced in the Mitchell case in New York?

"A. Only a general report or statement from Mr. Collier of new evidence that he was able to bring to bear upon the case, and a very hopeful, sanguine statement of the probabilities: WE FELT LIKE RISKING FIVE THOUSAND DOLLARS IN THE VENTURE.

"×Q. 100. Had you, or had you not, any information as to what attorneys were conducting the defense in the Mitchell case, or as to what opinions they had given as to the effect of the evidence produced there?

"A. I think that names of the attorneys, and that they were prominent ones, were mentioned, but I do not recollect now the names.

"×Q. 101. Question 100 read to witness.

"A. I only recollect that Mr. Collier made a general statement of gaining his case; I do not recollect details of opinion, evidence, or testimony.

---

*He should have said "*within four years,*" as the contract was dated June 15th, 1870, and the Mitchell case not decided until March of 1874.

"×Q. 102. You can make any further statement you desire "now.

"A. Well, I will make a statement in connection with this "contract. Since the master was appointed, we notified "Mr. Collier and Mr. Werk of the position of the case, "and that a master had been appointed; Mr. Collier has "not found time to reply to our letter; Mr. Werk came "over immediately, and says, 'What is this?' I said, "'This is the contract you signed; you went upon Mr. "'Collier's security.' 'Why,' he says. 'Well, is that "'so?' says he. 'I most forget; it was somewhere in "'my head that I did do that thing, but I do not recol-"'lect it.' Says he, 'I would like to see that paper.' So "the paper was locked up in Mr. Ramsey's safe, and I "did not get it for a few days, but I got it and gave it to "him; but I have not seen it since. That is the whole "thing of the paper. Another thing, the paper has "never been out of our possession or shown to any per-"son at all; in fact, it might be said to have been almost "forgotten, as it was stowed away in our safe among "other documents."

Conclusion.

Now your Honors have before you the whole history of this infringement.

Had these defendants entertained an intelligent doubt as to the validity of this patent; had they gone to respectable counsel and obtained his adverse opinion to it, and had they, confiding in this opinion, elected to cancel their contract in the face of the risk, that they would have to account to the patentee as infringers, it might be said that the equitable rule, though just, was hard.

But what are the facts?

These defendants had before infringed, they had before been brought into court, and doubtless by the advice of their counsel they had confessed the justice of the complainant's claim and settled with him.

Brought, then, into intimate business relations with him, they had enjoyed the benefit of his experience, of his advice and assistance in the improvement of their methods and apparatus for carrying on their business.

At the expiration of the original term of the patent, they renewed their contract with him, and until the spring of 1870, were well content to pay him the small fraction of their enormous gains from the use of his process which he asked by way of royalty.

At this time a lawyer from a distant city came to Cincinnati and sought out these defendants to volunteer his opinion that the patent was bad. But this did not influence them, and so far from acting upon it they informed Mr. Collier that they were quite satisfied to pay Mr. Tilghman his royalty.

Then Mr. Collier sought to influence them by proposing that if they would contest Mr. Tilghman's patent, *he would guarantee them against any loss.* But this proposal they simply laughed at.

Then Mr. Collier, who was doubtless acting for Mr. Werk in the whole transaction, offered them Mr. Werk's guarantee, and cut down his contingent fee to $5000. This they accepted for the reason, as Mr. Proctor says, "WE FELT LIKE RISKING $5000 IN THE VENTURE."

There is not an extenuating circumstance that can be urged for these defendants.

They deliberately took, what they had no reasonable doubt, was Mr. Tilghman's property, for no other reason than because a rich man and a bitter enemy of Mr. Tilghman's, was so anxious to injure him, that he contracted with them, that he would stand between them and the law. He would make good to them the difference between the royalty and their gain if they were beaten, and if they were successful, they should keep all the royalty to themselves.

Could there be a better illustration of the truth announced by this court in Rubber Co. *vs.* Goodyear, that any other rule than that of making the infringer account for profits would "*offer a premium to dishonesty, and invite to aggression.*"

The defendants induced the court below to step into Mr.

Werk's place and stand between these infringers and the consequence of their most unjustifiable acts, but we do not believe that this court will sanction a rule which will not only "invite to aggression" but also put so great a "premium upon dishonesty" as to practically make it impossible for even an honest man to justify himself in entering into a contract with a patentee. Why should he? Counsel would be bound to advise him that the courts had assumed the power of making contracts for patentees and had bound themselves to give better terms to infringers than those which the owners should presume to make with licensees, and that by infringing they would not only have the benefit of long delay, and the chances of death and financial inability to prosecute, but the certainty of having to pay no more than the most favored licensees.

We submit that, even if this were a suit at law, the judgment of the lower court would be unjustifiable, for the circumstances of the infringement, the conspiracy with Werk and Collier, and the position of the defendants as hired and bribed robbers of the patentee, call imperatively for the exercise of the power given to a judge to treble the damages.

COMPLAINANT'S EXCEPTIONS TO THE MASTER'S REPORT.

We have already (*ante*, pages 15 to 30) explained the principles on which the accounting was conducted, and stated the facts and testimony upon which the complainant relies to make out the gains and savings for which the defendants are accountable. On pages 30 to 37 we have given the substance of the master's report, and on pages 34 and 35 we have briefly stated the points as to which we contend the master was in error, our exceptions in full being printed in the assignments of error, pages 38 to 42.

In the arguments before the master and the lower court de-

fendants have constantly referred to the large amount of the recovery which we claim, as though that were itself a reason why this court should apply different rules to this case from those applied in cases involving less money, and we do not think that we are doing an injustice to the master and the court in saying that they were both influenced by this consideration, the master being induced by it to devote his attention to seeking out theories on which he could base deductions from the savings actually accruing to defendants, rather than to a close and intelligent understanding of the facts before him.

That the large amount of our claim should have caused the master to look very closely into the facts on which it is based, we anticipated; and that these facts will be most thoroughly weighed in this court we feel assured, and on this confidence we base our expectation that this court will approve our exceptions.

The fact that the savings are large we appeal to as proof of the importance of the invention—of the ample consideration which Mr. Tilghman gave to the country for the limited monopoly which the Constitution and the laws afforded him, and we have no fear that in this court the great value of the invention will be deemed a reason for considering the patentee's claims upon less liberal rules than are applied to minor inventors.

The Method of the Account Correct.

The theory or method upon which the account is stated is undoubtedly correct, as it is that laid down by this court in Mowry *vs.* Whitney, and the finding that the old lime saponification process was the best open process is unquestioned, but we ask the court first to consider what we contend is

THE MASTER'S ERROR IN COMPUTING THE CHEMICAL SAVING ON THE ALLEGED AVERAGE USE OF LIME AND ACID BY OTHERS INSTEAD OF ON THE PROPORTIONS ACTUALLY USED BY THE DEFENDANTS.

(1.) FACTS AS TO OLD PROCESS.—LIME.

Theoretical combination of lime and fat acids.

The theoretical quantity of lime which chemically combines with fat to form a lime soap is 9.35 per cent. of the weight of fat.

Excess of lime necessary.

It is undisputed that in the practical use of the old process it was invariably necessary to use an excess of lime over that theoretically necessary.

Why necessary.

This is easily understood when we consider the nature of the chemical action and the character of the treatment.

In the old process, great tubs of fat containing several thousand pounds were saponified by long-continued boiling and mixing with lime and water; the formation of lime soap went on from the beginning to the end of the treatment, but as it becomes a hard stone-like mass it would not only interfere with the stirring of the contents of the tub, but also would, to some extent, form around and enclose both particles of unsaponified fat and particles of free lime; such particles of lime were, of course, rendered inert, and it was, therefore, absolutely necessary to supply more lime to take their place. What this excess should be was, of course, determined by each manufacturer from the results of his own experience, and the perfection of the decomposition depended entirely upon it. It is not probable, that as carried on by practical men, an absolutely chemically pure fat acid was ever produced; what manufacturers understood to be a perfect decomposition, was one which gave them products fitted for

their uses, and they neither knew nor cared about the exact chemical composition of their products.

(See Gamble, pages 1347–8, Qs. 50–7.)

(Emery, page 1493, Qs. 70, 82–4.)

In the Roret article, page 1556, the old process of saponification and its conditions are described as follows:—

"While admitting the necessity of the agitation of the "mass to be saponified, we believe that we ought to "remark that in the other kinds of saponification *expe-* "*rience has demonstrated that we cannot succeed in saturat-* "*ing completely and economically the fatty bodies except by* "*saponifying them in two periods of time* (*en deux temps*). "*In fact, the fatty bodies are not soluble in water, and in* "*general chemical decompositions do not often take effect* "*thoroughly* (*avec netteté*) *except when one of the substances* "*is in complete solution in that liquid.*

* * * * * *

"Again, there is another consideration which prescribes to "some extent—to make the saponification at two periods, "or at least to make several periods in this operation; it "is that *the lime soap which is formed by the simultaneous* "*mixture of the whole quantity of lime intended to be used* "*on the fat acquires a great density, and in precipitating it* "*envelops part of the unsaponified fat, which is thus with-* "*drawn from the action of the lime; hence arises the neces-* "*sity of almost continual agitation to break and disintegrate* "*these masses of soap, and to put all parts of the fat in con-* "*tact with the lime.* We insist, then, on the adoption of "this saponification in two or more periods.

"It appears, besides, that this idea has not escaped certain "manufacturers, for Prof. Joeckel, in his description of "the German manufacture of stearic candles, published in "1841, writes thus: Everybody knows that the manu- "facture of stearic candles commences by the saponifica- "tion of the tallow. With this object we melt the tallow "with a sufficient quantity of water in a suitable tub "heated by steam, and while the heat is slowly rising we "add, in the form of milk of lime, such a quantity of the

"lime as will suffice to saturate all the free acids which "we suppose to exist in the tallow and which are not "combined with glycerine. *The addition of a larger "quantity of lime at the beginning of the operation, and es- "pecially at the moment when the heat is rising rapidly, "would act in a disadvantageous manner, because it would "hasten too much the formation of the lime soap, and would "be the cause that a part of the undecomposed tallow would "find itself withdrawn from the action of the lime.* In con- "sequence, while the heat is rising, we ought not to give "all the required quantity of lime at one time, but to re- "serve a portion which we add by degrees, allowing the "substances to combine together, under the influence of "the continual current of steam, until the lime soap is "completely formed: we know that this point is arrived "at, and that the operation is finished by the almost in- "stantaneous change which takes place in the consis- "tence of the liquor, which begins to precipitate granular "masses of a sharp fracture. Besides, it is necessary not "to neglect the other significant signs which are observed "in the manufacture of common soap from tallow. *The "quantity of lime necessary to saponify 100 kilograms of "tallow can be fixed without fear at 14 kilograms. An- "other useful observation is presented, viz., that the saponi- "fication of fats by lime can scarcely be executed rapidly and "completely, except under a pressure greater than that of the "atmosphere."*

In the testimony of the defendants' expert witness Grasselli, page 554, there is also a description of the old process as used in France, and he states that

"They saponify about 100 pounds of tallow by from 20 to "24 pounds of quicklime."

That so great an excess of lime was ever thought necessary proves conclusively that the old process was one which could at the best accomplish but a partial decomposition.

In this connection we will also refer the court to an experiment with the old process made by the arch expert Morton (see page 1456), where, after six hours' treatment with

14 per cent. of lime, the fat on analysis showed 30 per cent. of unaltered fat in the product.

What governs the excess used in practice.

Clearly, every manufacturer using the old process would adopt such a percentage of lime as would give him commercially satisfactory products. Since every pound of lime necessitated the use of a large proportion of sulphuric acid to get rid of it, the manufacturer would use just as little as he could, and the percentage adopted in use would be that which his experience taught him would be most profitable. Above this, the increased cost of chemicals would exceed the increased value of the product. Below this, the decreased value of the product would exceed the saving in chemicals.

Testimony as to the percentage of lime used.

We have already referred to the use of 20 to 24 per cent. as testified by Grasselli (page 554, Q. 2).

In the *Koret article* the proper quantity is stated as 14 per cent.

F. Verdin (Mitchell's partner), page 402, gives the proportion as 8000 of fat to 1120 of lime, just 14 per cent.

J. Verdin (page 164, × Q. 149) also gives 14 as the standard.

Michael Werk in his answer (page 490, bottom of page) states that in the old process he used 14 per cent. of lime.

Andrew Spies, employed by Mr. Werk, on page 566, Q. 3, says :—

"Before using the tank in cooking, I used from 11 to 14 "pounds lime to every 100 pounds fat. *I found 14 pounds "to do best.*"

C. T. Jones (page 37, Q. 2) used 14 per cent.

Willson, in a lecture delivered in 1856 (see page 125), states that 14 to 16 per cent. of lime were the standard proportions.

The Jury of the London Exhibition of 1862 (page 846) refers to 14 per cent. of lime as the standard use of the old process.

Endemann (page 1270, × Q. 5) stated that 14 per cent. of lime was used in the German factories.

The defendants, we know, used 14 per cent. of lime, and Mr. Gamble, Sr., testifies (page 586, Q. 2, and 1217, Q. 4) that at one time they tried 13 per cent. and returned to the old standard use of 14 per cent.

As to the use of a less percentage of lime, the testimony is as follows:—

Mitchell (page 868, × Q. 102) speaks of the use being from 12 to 14 per cent. F. Verdin, his partner, and J. Verdin, his employé, having testified to the regular use of 14 per cent. in his own works, it is permissible to comment on this as a prevarication intended to diminish his accountability.

George Shillito (page 590, Q. 2) says:—

"When we first commenced we mixed the stearine or stock "with from 12 to 14 pounds of lime."

F. X. Wiedemer (page 589) says:—

"We used from 11 to 14 pounds of lime to 100 pounds of "fat under the old process."

C. H. Grant (page 571, Q. 2) says he used 12 to 14 per cent. of lime by the old process.

N. Ropes (page 134, Q. 2) says:—

"We formerly worked in an open tub with *about* 13 per "cent. of lime; I say *about* 13, because sometimes it may "vary a little," &c.

N. Ropes, Jr. (page 144, Q. 2), describes the old process in general terms, and says that from 11 to 13 per cent. of lime was used.

All of these witnesses were called by defendants, and were in sympathy with their effort to show the least possible saving. Their testimony is certainly *not* of such a certain and definite character as to be weighed in connection with the positive testimony of the witnesses and publications which refer to 14 or more per cent. being necessary, and warrant the master's finding that 13 pounds of lime was the average use of the trade.

Conclusion.

After considering the above testimony, which we believe to be all that bears on the question, we think no other conclusion can be come to than that the regular use of 14 per cent. of lime was a necessity in the old process, and should be

adopted as the standard with which to compare the new process.*

(2.) Facts as to Old Process—Acid.

As to the quantity of acid used by the different manufacturers, there would seem by the testimony to have been considerable difference. Its use was, of course, regulated by considerations of economy in the same way as was that of the lime. *Jones* (page 37) states that he used 2½ pounds of acid to each pound of lime. *Willson* (page 125) speaks of the use as from 28 to 32 per cent. of the fat. *Ropes* (page 134) says he used *about* 2 pounds to the pound of lime. *J. Verdin* (page 181) says *about* 2 pounds to the pound of lime, as do also F. Verdin and Mitchell. *Werk* (page 490) says he used 36 pounds to the hundred of fat. *Grasselli* (page 555) says it was always used in excess. *Shillito* (page 590) says he used 2½ pounds to one of lime, and *the defendant Gamble* (page 587) says they (the defendants) used 3 pounds to the pound of lime.

If all of this testimony is to be considered as having equal weight, the master's finding of an average use of 2½ pounds of acid to one of lime is correct, but it is for the most part uncertain and indefinite, and evidently with a tendency to underestimate the quantity used. This evidence also lacks a most essential requisite of pertinence in that there is nothing to show the quality and value of the fatty acids produced by the different manufacturers, and it is clear that using insufficient acid would be but an extravagant economy.

The standard of comparison should be the old process as used by defendants.

---

* The correction of the master's finding that the old process used 13 per cent. of lime and the adopting of 14 per cent. as the true standard will make the defendants' saving in lime $10,690.54, and as the use of each pound of lime necessarily required a proportionate quantity of acid, the master's finding as to the saving in acid would, of course, have to be increased. Assuming that he was correct in finding that each pound of lime required but 2½ pounds of acid, we would have 580,842 pounds of acid over the quantity reported, which, at 2½ cents, would be worth $14,521.06; and the total saving in acid would be $197,242.52.

The defendants, while using the old process, used 14 pounds of lime and 42 pounds of acid for each 100 pounds of fat. As we have already noted, they tried to use less lime and could not. Gamble (page 1217, Q. 4). *To this day they use the same proportion of acid to extract the 1 per cent. of lime they use in the infringing process* (see page 1213, Q. 46). Now these defendants had long experience both in the old and new processes, and from small beginnings they built up a large and thriving business. It is evident, therefore, that they used the old process to advantage, and that the proportions of chemicals used by them closely approached the true mean between an extravagant perfection in decomposition and an extravagant economy in chemicals.

Another reason for accepting it is because it is the only proof actually taken *in this case* on the question, and being the evidence of the defendants themselves which they had full opportunity and reason for qualifying, if they could, it seems hard that they should now be permitted to break it down by the process of averaging it among a lot of incomplete and indefinite statements hunted up by counsel in the old record.

Conclusion.

The defendants' use should be adopted.

(*a.*) Because it unquestionably measures the saving which they actually effected.

(*b.*) Because it was presumably the most economical form of the old process.

(*c.*) Because it is the only use as to which there is testimony as to the results as well as the means.

(*d.*) Because it is the only use proved by certain and definite testimony.

(*e.*) Because it is the only use proved directly before the master and in no way qualified by defendants.

The court can hardly escape from the conviction that the master was in error in rejecting this evidence, for that is what he virtually did when he averaged it among the old incomplete

statements, and we submit that our first exception must be allowed.*

The correction of this error will make the defendants' saving in lime $10,690.54 and in acid $229,784.11.

THE MASTER'S ERROR IN REPORTING THAT DEDUCTIONS SHOULD BE MADE FROM THE CHEMICAL SAVINGS MADE BY DEFENDANTS BY REASON OF THEIR USE OF ALLEGED MODIFICATIONS OF COMPLAINANT'S PROCESS.

If water process practicable defendants' chemical savings are due solely to its use.

Of course we do not mean that if, by reason of any invention or device, patented or unpatented, these defendants have increased their gains or savings, that they are accountable to us for such increase. What we do say is that the chemical savings—the lime and acid—are all the direct result of the defendants' use of Mr. Tilghman's process.

Mr. Tilghman's discovery was that liquid water at a high temperature will decompose fat, and his process, as compared with lime saponification, may be said to consist simply in omitting the use of lime and acid and substituting for them heat.

That the result of substituting the water process for the lime process, is to save the lime and acid, necessarily follows, it is too clear for argument. If the defendants have, by the use of a modification of the process or of some improvement in apparatus, made an *additional* gain or saving, it *can* only be in the items of *labor*, *time*, *fuel*, and the like, which are in no way included in the inquiry as to the *chemical savings*. Such

* The testimony and facts referred to as showing the nature of the old process and its necessarily incomplete decomposed product are also pertinent to the discussion of our seventh, ninth, and tenth exceptions, but to put our case clearly before the court, we think it best at this point to pass to what we consider the fundamental errors of the master, and will take up the subject of the character of the products of the old process again further on (*post*, pages 137 to 144).

additional savings are untouched, and remain the unquestioned property of the defendants.

Only possible to dispute chemical savings by claiming that water alone is inefficient.

There is but one possible assumption upon which the fact that the *chemical savings* were due entirely to the complainant's process can be assailed or disputed, and that is the assumption that water alone, without the "modifications," will not effect a commercially satisfactory decomposition of fat.

If water will thoroughly decompose the fat, but the addition of some other chemical or of some mode of treatment not contemplated by the patentee will enable the decomposition to be effected in less time or at a lower heat, the gains effected by the "modifications" can only be gains in the labor and fuel required, and such gains are in no way included in or connected with the chemical savings. Mr. Tilghman showed them how to save the lime and acid. For that saving they are accountable; if they have been able to effect other savings or gains by "modifying" his process, they retain them, since we have sought no accounting from them for such savings.

If, on the other hand, water alone will not effect a commercially successful decomposition of fats, and it is only by adding to Mr. Tilghman's process a subsequently discovered modification that the decomposition of fats can be practically carried on; then, undoubtedly, the "modifications" would be efficient factors in effecting the chemical savings, and it would be error to hold that they were all to be credited to the patented process.

We submit that there is no escape from the above conclusions. If highly heated liquid water will in practice produce *standard commercial fat acids*, then the chemical savings of the defendants were due simply and entirely to their infringement on the patent.

Defendants fully appreciated position,—and denied practicability of water process.

We do the defendants no more than due credit when we say that they fully appreciated the irresistible logic of the

position we have just explained. In view of the facts, there were but two courses open to them—one to admit that their chemical saving was solely due to the infringement; the other to contend that water *alone* was an inefficient decomposing agent.

They elected to dispute the claim, and undertook to show that the patented process was not practicable, and that their use of it was with certain modifications, which were absolutely *essential*, and by which the production of commercial fatty acids was rendered *possible*.

These alleged modifications are as follows:—

First.—Their use of 1 per cent. of lime.

Second.—Their use of a double dose of water.

Third.—Alleged advantages due to their apparatus.

Opinion of this court as to modifications.

All of these pretended modifications of the complainant's process are thoroughly ventilated in the main record, and were pressed at the former hearing. They are discussed in detail in the opinion (see *supra*, pages 9 to 13), the court concluding its review by saying:—

"CAN A BALDER CASE BE CONCEIVED, OF AN ATTEMPTED "EVASION AND A REAL INFRINGEMENT OF A PATENT?"

What defendants undertook to prove.

In spite of the finding of this court, and in the face of the most conclusive evidence to the contrary already in the record, the experts produced by the defendants testified that, in their opinion, based on a careful examination of the proofs already in evidence, on an exhaustive search into the literature of the art, and on experiments carried on under their direction, it was impossible to produce a commercial fat acid by means of heated water alone, and that a little lime, as used by defendants, was absolutely essential to the practical success of the process.

How they treated the old proofs.

If these expert gentlemen, Messrs. Endemann and Morton, had really made a careful examination of the old record, it is not likely that they would have gone into this attempt to

show the impracticability of the process with water alone. Finding, however, in such examination as they made, some testimony denying the efficiency of water without lime, and assuming that the evidence of the chemists called by the complainant was all that there was to rebut it, these gentlemen thought to dispose of their evidence and show that the question was still an open one by condemning the mode of chemical analysis used by the expert witnesses on both sides up to the accounting, and which they claimed was shown, by means of a brand new method which was just published, to be unreliable.

Morton's evidence, Record, pages 1370 to 1372, from which we extract the following:—

"I have not been able to find in the record anything that "proves to me as a chemist that in any of the experi- "ments made and recorded in that record where the "Tilghman process, as I have already defined it—that is, "where water, heat, and pressure were the sole agents of "saponification—was used, that such process yielded a "substantially saponified product, or, in other words, a "product consisting substantially of free fatty acids and "glycerine without a large percentage of neutral fat.

* * * * * *

"A careful study of the references to this subject which I "have found in the record leaves in my mind the con- "viction that this is an unsettled question as far as the "evidence so far adduced is concerned, and, as my ex- "periments have invariably shown me that a thorough "saponification cannot be produced under any conditions "that I could secure by the use of heat, water, and pres- "sure alone, I feel confident that the opposite impression "produced in the minds of these witnesses by their ex- "periments comes simply from the fact that they had not "at their command and did not use such reliable methods "of analysis of mixtures containing fat acids and unde- "composed fats as have been recently introduced and "were employed by me in testing the samples of product "which I obtained."

Defendants' "Literature of the Art."

Having as they supposed found a way of discrediting the proofs of the old record, Messrs. Endemann and Morton proceeded to the proof of their proposition that water would not practically decompose fat, by swearing that they had carefully examined the literature relating to the decomposition of fats, and that they found from it that it was a notorious and admitted fact that the water process alone was impracticable.

Thus *Endemann* testifies, page 1256, as follows:—

"Q. 37. Are you familiar with the literature relating to the "process of decomposing fat into fatty acids and glycer- "ine?

"A. Yes, sir. I do not say that I have read everything, "but I have read a good deal about it.

"Q. 38. Do you know, either from your practical obser- "servations or from any information obtained by your "reading and studies, of the separation of fat into fatty "acids and glycerine being carried on, on a manufactur- "ing scale for practical purposes, either now or in the "past, by the use of water, heat, and pressure, without "other agents; if so, how extensively?

"A. My knowledge of the literature or printed publica- "tions is that various attempts have been made in Europe "and elsewhere to introduce saponification of fat by "water, heat, and pressure; but they all, as far as my "knowledge goes, have been abandoned on account of "the fact that a complete saponification of fat by water "alone is impracticable."

* * * * * *

He continues by referring to a number of books as sustaining his assertion, the one most prominently mentioned being Wagner's year-book from which he quotes (page 1256) the extract which the defendants put in evidence as their Exhibit No. 2 (see page 1524), and he concludes by saying:—

"Similar statements with regard to the insufficiency of "water, that is water under pressure and corresponding "heat, are found throughout the literature."

Defendants' Experiments.

Having discredited the old testimony, and shown that "the literature" of the art discredited the unmodified process, the experts proceeded to demolish it utterly by a series of experiments.

First.—Doctors Endemann and Morton made a little apparatus shown in the drawing. defendants' Exhibit No. 30, and by means of this they made a pair of parallel experiments, heating fat and water together, in the one case without lime, and in the other with 1 per cent. of lime. They operated their little machine at a pressure of *ninety* pounds and at a corresponding temperature, and continued the treatment in each case for *six* hours.

An analysis by Dr. Endemann showed the fatty acids in the product to be 61.83 per cent., but Endemann's analysis being pretty thoroughly discredited when he left the witness stand, Morton re-analyzed the product and found that there was really 70 per cent. of fatty acids present.

Second.—Doctors Endemann and Morton directed and overlooked a pair of experiments in the defendants' digesters in their works at Cincinnati, in which the fat and water were heated together, at a pressure of *one hundred and thirty-one* pounds for nine hours; in the one case with lime, and in the other without lime as before.

In the digestion with water alone, the analysis showed 76.47 per cent. of fatty acids.

In the digestion with lime, analysis showed slightly over 88 per cent.

Three other experiments were made in defendants' digesters, as follows:—

Third.—A charge of fat and water without lime was treated at 150 pounds pressure for fourteen hours.

The original analysis by Endemann he stated showed 88.81 per cent. decomposition, but renewed analysis by Morton, while under cross-examination, showed by three tests, respectively 90.1, 90.6, and 92.46 per cent. of decomposition.

Fourth.—A charge of fat and water with 1 per cent. of lime was treated for eight and a half hours at 150 pounds pressure.

Endemann reports his analysis of this product as showing 97.5 per cent. decomposition, but, as usual, the check analysis of Morton's, which was three times repeated, showed that in fact the decomposition was less, his results being 94.3, 94.4, and 94.9 per cent.

Fifth.—A charge of fat and water alone was treated at 131 pounds pressure for eighteen hours.

Analysis showing 84.43 per cent. of decomposition.

These tests were tabulated by Morton and offered in evidence as defendants' Exhibit No. 14 (Rec. page 1531).

Sixth.—The defendants caused a machine to be constructed of the kind described in the complainant's patent, and Endemann, Morton, and some others were present when it was operated. This coil the witnesses claimed was both built and operated according to the directions in the patent.

Analysis of samples of the product of this machine showed a decomposition at lead-melting heat, and what was claimed to be ten minutes exposure to it, of about 80 per cent. (see Endemann, page 1253).

On the basis of these experiments defendants' experts testified most positively that, in their opinion as chemists, it was absolutely impossible to decompose fats to a practically useful extent by water alone at any heat and pressure, and that the use of lime was simply *essential*. Their testimony is chiefly devoted to stating and supporting this opinion. As examples of their positiveness and certainty we give the following:—

ENDEMANN page 1267.

"Q. 97. Is or is it not practicable to carry the process "where heat, water, and pressure alone are used to what "you refer to as a complete separation?

"A. It is, according to the literature I have quoted, and "according to my own experience, *impossible* to carry "the water process to a successful end in the manner in "which it has been described in the Tilghman patent.

"Q. 98. *Is it practicable in any other manner that you know "of?*

"A. *In no manner that I know of.*

"Q. 99. Now, having reference to results actually obtained

"in the saponification process carried on by water, heat, "and pressure, without other agents, what would be the "per cent. in utility, as a means of working upon a "manufacturing scale, between this process and either "the old lime-saponification process or the distillation "process?

"A. This would entirely depend upon the result which is "desired to be obtained. If it is desired to make pure "stearic acid, and get the highest yield and an excellent "product, the process by water, heat, and pressure alone "*would never be used.*"

MORTON, page 1372.

"Q. 30. Referring now to the process of saponification "recited in defendants' answer as that used by defend- "ants, can you state about what is the efficiency in their "process of the one per cent. of lime mentioned as there "used, giving your reasons for any opinion you may "express?

"A. From the experiments which I have made myself, and "others which I find in the record, or which have been "made at my request, *I am of the opinion that this one* "*per cent. of lime practically effects a gain of about twenty* "*per cent. in the amount of free fat acid obtained as a final* "*result in this manufacture*—that is, I include in this the "fat acid obtained from the lime soap as well as the acid "free at the moment the material is taken from the tank. "As this draws my attention to it I might state here that "wherever I have spoken of the free fat acid in these "products where lime was used I include that portion of "acid which was combined with the lime and was sep- "arated by the subsequent treatment with sulphuric "acid. The fat acids produced by these processes are "always subjected, as a matter of course, to the treatment "with sulphuric acid to clarify them, and, therefore, it "did not occur to me to specifically state this before. "*This is the actual numerical difference which appears to* "*result from the treatments* (*otherwise identical*) *with and* "*without lime.* Besides this, however, there is another

"view of the efficiency of the lime in this relation. *It "would also appear from my own and all the other experi- "ments with which I am acquainted that the production of "a practically thorough saponification without lime or some "other equivalent material, or in other words by the action "of water, heat, and pressure alone, cannot be obtained and "never has been obtained either on the laboratory or com- "mercial scale.* And therefore the efficiency of the lime "in securing this result may amount to much more than "an increase of 20 per cent. in the total amount of free "fatty acid obtained from the process, for it is manifest "that 20 per cent. or even less of undecomposed fats left "in the mixture will act very disastrously upon the sub- "sequent steps in the treatment."

We have now stated the whole of the defendants' case as it was originally planned and developed before the master, excepting only their attempt to set up steam distillation as a standard open use. We have stated it as they would have done if it had not been demonstrated to be false and untrue, and we now ask the court to consider the facts.

Complainant's Reply.

The old proofs.

Defendant's experts contradict not only eminent chemists but practical manufacturers.

When Mr. Morton gave his ingenious reason for discrediting the testimony of the experts and others who in the old case testified as to the perfection of the decompositions effected by the water process, he was not only pitting his judgment against that of such eminent chemists as Booth, Genth, Rogers, and Gibbs, but he was oblivious to the fact that the samples were themselves produced and examined by Mr. Werk and other hostile, but practical manufacturers, who did not themselves or through their experts question the fact that they were a good commercial fatty acid. That chemists when retained as witnesses may make very serious mistakes, your Honors will be satisfied when you have followed Mr.

Morton and his fellow Endemann through this case, but that practical manufacturers of fatty acids don't know the commercial article when they see it you will not easily be convinced of.

Defendant's experts ignorant of facts in record.

But this is of comparatively little moment. Messrs. Endemann & Morton in their examination of the old record had overlooked the fact that it is made up of testimony taken in three cases, two against Werk, who first used 7 and afterwards 4 per cent. of lime, and one case against Mitchell, *who used no lime at all.*

Werk's line of defense was the same which these defendants adopted, viz., that the lime was essential.

Mitchell, who never used a particle of lime in his digesters, couldn t use this theory to advantage, so he claimed that his process embodied the "modification" of *mixing* the fat and water.

Morton and Endemann had read enough to get hold of Werk's theory, and finding it to suit all their needs they adopted it without noticing that Mitchell had worked with water alone.

Facts shown them—how treated.

As an example of how far the devotion of some "experts" to their employers and their theories can go, we will quote the testimony of *Endemann* when the Mitchell use was called to his attention, pages 1285 to 1287.

"× Q. 103. Are you acquainted with the process described
" in the patent to Wright and Fouché, a copy of which
" is annexed to the record as Exhibit Patent Wright and
" Fouché, on pages 243 to 246 (now page 279)?

" A. I am; not by any diagram found in the record, for
" there is none, but by description found in literature.

"× Q. 104. *What are the chemical agents used in the process*
" *as you understand them?*

" A. *Water, under heat and pressure, acting upon neutral fat.*

"× Q. 105. What are the products of that operation?

" A. It is claimed in the patent that decomposition of the

"fat into free fatty acids and glycerine is produced. "Whether this is a complete reaction—that is, whether "all the fat can by this process be converted into free "fatty acids and glycerine, is, according to my own ex- "periments and some of the exhibits produced by me, "not only doubtful, but *it is acknowledged that in this "manner a complete decomposition cannot be effected.* I refer "here to Exhibit "Birnbaum," which I presented in the "early part of my examination.

"× Q. 106. *Do you know as a matter of fact that this pro- "cess by heat, pressure, and water alone has been carried "out, on a large scale, by R. G. Mitchell in the Wright & "Fouché apparatus?*

"A. *No, sir;* I have asked you to refer me to the page.

"× Q. 107. I refer you to question 16 on page 749 (page "852), questions 1, 2, 3 on page 746, and repeat the ques- "tion.

"I see there from that Mr. Roland G. Mitchell has used the "Wright & Fouché apparatus. It is not stated to what "extent this special process has been carried.—I find in "his answer to third question, that about 40,000 pounds "of fat per week were saponified, and in answer to ques- "tion 2 it is stated that part of the time the lime process "and part of the time the water process without lime "was used. There is no clue as to how long either of "these processes was in use.—By the manner answer to "question 16 is given I would suppose that, at the time "of this examination, 1869, this process was the only "one used in his factory.

"× Q. 108. *I further refer you to cross-question 52, same "witness, on page 755.*

"A. *The information obtained from this is that Mr. Roland "G. Mitchell has manufactured 11,500,000 pounds of fat "into fatty acids and glycerine, between 1860 and January "9th, 1868, by the use of the Wright & Fouché apparatus "and process,* OR, IN OTHER WORDS, THAT HE HAS SPOILED "SUCH AN IMMENSE AMOUNT OF FAT BY MEANS OF THIS "PROCESS.

"Q. 109. Please state the grounds for the assertion in the "latter part of your answer.

"A. *The process is known to carry the decomposition only "to a certain extent, leaving always a considerable quantity "of unsaponified fat in the acid mixture.*

"× Q. Can you give any probable reason why Mr. Mitchell "continued, in 1869, to spoil 40,000 pounds of fat per "week, after his experience during eight years preceding, "upon the manufacture of 11,500,000 pounds of fat?

"A. I cannot.

"× Q. 111. In the process carried on in the Wright & "Fouché apparatus, as described in the record, are not "heat, pressure, and water alone the efficient agents in "decomposing the neutral fats into fat acids and glycerine?

"A. *I consider, as the efficient agents in the Wright & Fouché "apparatus, merely the water at high temperature.* The "pressure I consider a necessary inconvenience, and of "value so far as it would tend to keep the water in a "liquid state.

"× Q. 112. Referring to page 945, questions 18 and 19, to "C. H. Grant, what is said about the quality of the candles "made by Mr. Mitchell?

"A. *The answer to question 19 states that the candles made "[by] Mr. Mitchell sell from six to eight cents higher than "the candles made by the licensees of Tilghman.*

"× Q. 113. I refer you to page 947, testimony of Henry "Bower, questions 1 to 7. Please state what was his "business and what he says as to the purity of Mr. "Mitchell's glycerine?

"A. The statement is to the efiect that Mr. Bower is en- "gaged in the business of refining glycerine; that he has "bought glycerine from parties working under licenses "from Tilghman, to the best of his knowledge: M. Werk "& Co., Cincinnati; Proctor & Gamble, same place; "Goodwin, Behi & Co., St. Louis, and A. Gross & Co., "of Jersey City; and *that he also bought glycerine from "R. G. Mitchell & Co., and that in making bids for good "glycerine he gave the preference to the latter firm, running*

" *to an extent from 25 to 33 per cent. above that furnished*
" *by others.*

"× Q. 114. Has the evidence to which I have referred you
" on the record produced any effect on your opinion as to
" the commercial quality of the fat acids and glycerine
" produced by Mr. Mitchell by means of the process
" using heat, pressure, and water alone?

"A. If this evidence is not contradicted and no other
" reasons might, probably, be given for the facts therein
" stated I should think that, as far as the glycerine is
" concerned, a better product had actually been obtained.
" I do not think that, from the price of daily commodities
" like candles, a deduction of the commercial value of
" the article can be made, as, in many cases, not the one
" who manufactures the best article, but the one who ad-
" vertises most, obtains the custom of the public. Un-
" less, therefore, I am acquainted with the affairs of the
" firm better than I can be by reading a few extracts I
" could not venture an opinion. Then, there is also to
" be taken into consideration that it is not the acid mix-
" ture sold in candles, but the acid mixture after further
" treatment.

"× Q. 115. You're of the opinion, then, that Mitchell did
" not effect a sufficiently complete decomposition of the
" fat into fatty acids to make his manufacture a commer-
" cial success; is that so?

"A. If Mr. Mitchell has made a commercial success I do
" not think it is due to the use of the Wright & Fouché
" apparatus, which *I know* does not produce a complete
" saponification.

"× Q. 116. How do you know this?

"A. I refer to Exhibit Birnbaum and Exhibit Kraut, 'Fat
" 'Industry in Glycerine,' produced by me. In the Birn-
" baum exhibit the names of Wright & Fouché are not
" mentioned, but the process is described consisting of
" the use of water under heat and pressure only.

" × Q. 117. Is the above all your authority?

"A. No, sir; there are also my own experiments."

Page 1293:—

"× Q. 158. *In giving your testimony as to the want of prac-*
"*ticability of the Tilghman process for use on a manufac-*
"*turing scale, did you have in view, and did you have any*
"*knowledge of, the fact of R. G. Mitchell's successful use of*
"*this process on many million pounds of fat?*

"A. *I did not have it in view.* In the testimony laid before
"me, and which I read on Saturday, nothing is said of
"the purity of the first fat acid mixture obtained; noth-
"ing of the additional treatment which was required to
"obtain a material for candles. *I am, therefore, by no*
"*means convinced that the first product obtained by this pro-*
"*cess possesses such purity that the working of the process*
"*will secure advantage.* The experience had in Europe
"of the use of this process, in my opinion, *seems* to prove
"that it is not an advantageous one. The process was
"carried out in the Wright & Fouché apparatus, which,
"according to Stass, has also been used by the Vienna
"manufacturers."

Complainant's proof of practicability of water process by Mitchell's use.

If the fact that Mitchell using the water process without modification made the best candles and the best glycerine in the country and got the highest prices for them was not sufficient to "convince" Dr. Endemann that the water process was a practicable method of decomposing fats, but on the contrary he was able still to believe that Mitchell had simply "*spoiled*" all the fat he had treated, we think it will be sufficient to satisfy this court that the process with water alone was quite *as efficient* as the process with water and a little lime.

Mr. Endemann's ingenious suggestion that the *best* candles could be practically made from "*spoiled fat*" is, to say the least, lacking in probability, and is rebutted by the defendant Proctor (pages 1331–2), who admits that when they (the defendants) made candles of similar grade to Mitchell's they had to use the best grade of fatty acid produced by them. See

also defendants' witness Baujard (page 1476), who states that the quality of candles depends upon the quality of the stearic acid, and that good candles cannot be made from poorly decomposed fats.

Much more proof of the efficiency of water alone could be cited from the old record, but we think Mitchell's use will be sufficiently satisfactory to the court.*

The literature of the art.

From the testimony of Endemann and Morton as to the result of their reading, it would certainly seem that the whole literature of the art was a unit in condemning the water process and asserting its impracticability.

Defendant's experts refer to but four books and misquote them.

An examination of the books to which they referred as justifying their testimony shows an almost ludicrous contrast between the witnesses' assertions and their premises. In the first place, the references are but four in number, namely—*Birnbaum* (defendants' Exhibit No. 1, page 1522). This article, published in 1877, is in substance an elaborate puff of a new process invented by one Bock, in which Bock's method is contrasted with the old method in use at a certain German factory, and which Birnbaum briefly describes as consisting "in putting the melted fat and water in a strong copper ves-"sel and heating the mixture until the pressure reaches four-"teen atmospheres."

There is no description of the apparatus and no mention of the *extent* to which the fat and water were *mixed;* nothing, indeed, to indicate that they were mixed at all.

Analysis, Birnbaum says, showed that by their old process the manufacturers were getting but an imperfect decomposition. But he says nothing as to the sufficiency or insufficiency of the water process in general.

Wagner's Year Book, 1863 (Defendants' Exhibit No. 2, page

* It is proved by Mr. Henry Bower that Mitchell continued the process without lime up to the time of the depositions in this case (see pages 1478-9).

1524). The extract translated and put in evidence by Endemann is a mere query as to whether under certain conditions a recombination of fatty acids might not take place.

Wagner's Year Book, 1864 (Defendants' Exhibit No. 3, page 1525) states that in an apparatus of the kind proposed by Melsens there was difficulty in regulating the temperatures, and that to produce a finely crystalline product it was found necessary to use from 1 to 2 per cent. of sulphuric acid. Not a word of commendation or criticism of the water process generally occurs.

Kraut (Defendants' Exhibit No. 10, page 15–27). This author states that the process of decomposing fats by superheated water introduced by "Tilghman and Melsens" "secured a temporary success partly by using the apparatus "constructed by Wright & Fouché. We do not know if this "method is still in use anywhere," and continues:—"This "much is certain, that the Vienna manufacturers reported to "be using this plan in 1863 by Stass, two years later had "adopted Milly's autoclaves."

Comparing these exhibits with the assertions of the witnesses concerning them they are assuredly, both in number and substance, but a weak support for the testimony, and would be at best of little weight as against the hard fact of Mitchell's use.

Fraudulent suppression of clear proof as to efficiency of water process.

One important use, however, this reference to "the literature of the art" has in this case, for it enables us to exactly gauge the honesty and good faith of the defendants' experts. To eke out their poor four instances of publications which might be taken by inference to impeach the efficiency of the water process, the experts introduced the translation from the Year Book of 1863 which we have referred to above, and they actually *picked the sentence* out from the middle of an article which tells of the *perfect decomposition* effected by the water process and explains the reasons *why* it has *ever* given poor results. We have put the whole article in evi-

dence (see context of Defendants' Exhibit No. 2, pages 1553), and it is as follows:—

Wagner's Year Book, 1863, page 664.

"The sentence printed in brackets is the whole of De-
"fendants' Exhibit No. 2."

"*On the industrial value of the preceding apparatus doubts*
"*have here and there been expressed; but a publicly per-*
"*formed experiment by Cloetz, in the Museum d'Histoire*
"*Naturelle, at Paris, has* ENTIRELY SET ASIDE THESE
"DOUBTS. *In a small apparatus of the above-described*
"*construction* (*Wright & Fouché's apparatus*), *8 kilo of*
"*tallow and 16 litres water were brought into circula-*
"*tion for 8 hours at a pressure of 15 atmos. and a tem-*
"*perature of 200° C.* THE PRODUCT OF 97.5 PER CENT.
"WAS OBTAINED OF BEAUTIFUL WHITE AND HARD FAT ACID,
"WHICH CONTAINED SCARCELY TRACES OF A SAPONIFIED*
"SUBSTANCE. THE EXCELLENCE OF THE SUBSTANCE OB-
"TAINED BY CLOETZ PROVES THE VALUE OF THE NEW PRO-
"CESS, *and shows that if in practice the apparatus has some-*
"*times yielded imperfectly saponified product, the fault must*
"*be ascribed to accidental circumstances, for example, of a*
"*too small quantity of water or a too low temperature, for,*
"IN THE SAPONIFICATION BY SUPERHEATED WATER, TWO
"CONDITIONS ARE ESPECIALLY INDISPENSABLE, NAMELY,
"THE MOST INTIMATE AND EMULSION-LIKE MIXTURE OF
"THE FAT AND WATER, AND THE USE OF A SUFFICIENTLY
"HIGH TEMPERATURE. With all apparatuses proposed
"care has been taken to keep carefully to the first
"condition.

["In regard to the necessity of a certain temperature it
"follows with certainty, from the truly classic researches
"of Berthelot, that, if at a certain temperature the neu-
"tral fats are decomposed by water into fat acid and
"glycerine, at a lower temperature a reunion takes place
"of the separated products into neutral fat.]

"If, now, when operating on a large scale, too low a tem-

* Clearly a misprint; the author meant *unsaponified.*

"perature and pressure be employed, especially in the "presence of a too small quantity of water, it is intelli- "gible how, with a continued contact between fat acid and "concentrated glycerine solution, a certain amount of "neutral fat can form and depress the melting point of "the product obtained."

Can your Honors recall an instance of more brazen and more stupid dishonesty, than the suppression of this clear assertion of the perfect efficiency of the water process and careful explanation of the only causes which could ever produce its failure?

With this before him Endemann swore that the literature of the art united in condemning the water process, and this is in itself not only proof that he was wrong, but proof that *he knew* he was wrong.

In view of the suppression of the context of Exhibit No. 2, by Endemann, it is hardly worth while to refer further to his dishonesty in relation to the literature of the art, but we will call the attention of the court to a few of the publications which, since they were exhibits in the old record, could hardly have escaped his attention.

Defendants' Experiments.

That the experiments made by the defendants and their experts do not, and cannot, prove that water alone *could not thoroughly* or even *practicably* decompose fats, is, of course, clear by this time. But they have a bearing, and an important bearing, on the case nevertheless, and should be carefully considered.

Made to conceal facts, not to show them.

In Mr. Tilghman's patent the importance of thorough intermixture of the fat and water is dwelt upon, and it is clearly stated that the decomposing power of the water increases as the heat and pressure are increased. The importance of intermixture and heat is also explained by Mr. Tilghman in his testimony (page 1156, &c.), and enforced by all the testimony in the old case. The vitally important relation of these features of the process to its efficiency could not therefore be unknown to the

defendants' "experts." But this knowledge is brought still closer home to them; they had hunted up, examined, and decided to suppress the context of Exhibit No. 2, where it is stated of the water process that "The excellence of the substance "obtained by Cloetz proves the value of the new process, and "shows that if in practice the apparatus has *sometimes* yielded "imperfectly saponified product, the fault must be ascribed to "accidental circumstances, *for example, of a too small quantity* "*of water or a too low temperature, for, in the saponification by* "*superheated water, two conditions are especially indispensable,* "*namely, the most intimate and emulsion-like mixture of the fat* "*and water, and the use of a sufficiently high temperature.*"

Knowing these facts then, and knowing that the defendants had, during their infringement, worked at a pressure of from 200 to 250 pounds (see answer), and knowing, we presume (for there is plenty of evidence in the old case to show it, and as chemists they must have known) that where the heat or mixture is insufficient they can be aided by the presence of a little alkali. These *experts* made their experiments at from 90 to 150 pounds pressure.

In *March*, a pair at 90 pounds, which showed about 20 per cent. in favor of the lime.

In *April*, a pair at 150 pounds, which showed about 2 to 3 per cent. in favor of the digestion with lime.

In *May*, a pair at 131 pounds pressure, which showed about 12 per cent. in favor of the lime, a third digestion with water alone continued for some hours longer showing a difference of only 4 per cent. from that with lime.

And on the basis of these tests Morton and Endemann swear that their experimental researches as chemists *prove* that water will not effect a satisfactory decomposition of fats. Morton, for instance (page 1377), referring to the product of the water treatment as one which would contain about 20 per cent. of undecomposed fat, and contrasting it with the old lime product which he here assumes would contain 95 per cent. of fat acids, and on page 1372, question 30, he states that he is satisfied that the use of 1 per cent. of lime will effect a gain of about 20 per cent. in the amount of fat acids produced in the

mixture. In view of the fact that his April tests at 150 pounds showed a difference of only 2 per cent. in the acidity of the products with and without lime, and a decomposition of 92 per cent. in the digestion with water, both of Professor Morton's above assertions are truly remarkable.

Even the May tests at 131 pounds which defendants tried *afterwards*, showed but 12 per cent. difference at best, and but 4 per cent. after nine hours' additional digestion with water; and the only difference of 20 per cent. is in the March tests, made at 90 pounds pressure and during but six hours. But the court will soon learn in reading Mr. Morton's testimony that, while ingenious and fertile in theories to a remarkable degree, he is equally remarkable for his forgetfulness or disregard of facts.

The point which we have especially in mind in spreading these "tests" on our brief is the very obvious one, that the low pressures (and consequently low heat) used in the experiments were (1.) entirely without pertinence, direct or indirect, to the defendants' use, which was at an average pressure of 225 pounds; and, (2.) were exactly what—as is pointed out in Wagner's Year Book,—in Tilghman's patent,—and in the testimony in the old record—would be sure to show the water process in the worst possible light.

The pretended *tests*, then, are of a piece with the suppression of the context of Defendants' Exhibit No. 2.

How Morton explains the reason why he made irrelevant experiments.

As bearing on the honesty of the tests we quote from Morton's cross-examination. (Page 1403–4.)

"× Q. 102. *At the time you were making these experiments,*
"*you knew, did you not, that during the period covered by*
"*this accounting the defendants used in their process the*
"*pressure of between 200 and 250 pounds to the square*
"*inch, and continued the treatment from nine to ten hours?*
"A. *I did.*
"× Q. 103. *Now, since, if I understand you correctly, the*
"*object of these comparative experiments was to determine*

"*what you conceived to be the advantage accruing to the*
"*defendants by reason of their use of 1 per cent. of lime,*
"*why didn't you take the same pressure and the same periods*
"*of time which they actually used at a time this advantage*
"*accrued to them, if at all?*

"A. BECAUSE I WAS UNABLE TO DO SO. *I understood from*
"*Mr. Gamble that one motive, if not the chief one, in re-*
"*ducing the pressure was a feeling of insecurity in reference*
"*to the boilers and the digesters.* I DID NOT FEEL AT LIB-
"TY TO MAKE AN EXPERIMENT WHICH WOULD INVOLVE SO
"VERY SERIOUS A RISK AS THAT WOULD HAVE DONE.

"× Q. 104. *Did Mr. Gamble tell you that he thought it*
"*would be dangerous to use a higher pressure than 130*
"*pounds or thereabouts?*

"A. *He did not;* but in the course of conversation he told
"me in substance what I have just repeated, namely, he
"did not feel easy to have the apparatus used at the high
"pressures they had run at before, and I gathered that
"this was the main motive in using lower pressures.

"× Q. 105. *Do you not know that up to within a month of*
"*the time you made your experiments those same digesters*
"*had been run at very much higher pressures?*

"A. *I have absolutely no knowledge on the subject.*

"× Q. 106. *Mr. Gamble did not tell you, then, that the use*
"*of such a pressure as you experimented with had only been*
"*commenced in his works within a week or two of your*
"*visit to Cincinnati?**

"A. *I have no recollection of any such statement.*

"× Q. 107. *When did your conversation with Mr. Gamble*
"*on this subject take place?*

"A. I think it was on the day when we were running the
"Tilghman coil apparatus, and it was in the course of a
"general conversation. THAT WAS MAY 11TH.

* In giving his testimony on May 25th, Mr. Gamble states (page 1349, Q. 66), that they had been using the lower pressure for "about a month." The tests at 150 pounds, it will be noticed (page 1531), were made on April 13th and 19th, which is more than a month before the 25th of May. It is not a violent presumption, therefore, that the change was made in view of the "danger" of the accounting.

"× Q. 108. THEN HE DID NOT MENTION THE DANGER TO YOU "UNTIL AFTER YOU HAD MADE THE EXPERIMENT?

"A. YES; THAT IS TRUE.

"× Q. 109. Then how can that be a reason for your not "using a higher pressure when you did make the ex- "periment?

"A. I did not inteud it in that sense. I intended it as a "reason why I did not also make the experiment at a "higher pressure. Under any circumstances I should "have made an experiment at the pressure which was "used in the factory when I came there, and I had "thought of using higher pressures, but gave up the "idea after this conversation with Mr. Gamble.

"× Q. 110. *You have absolutely no data, then, which will "enable you to state what the comparative efficiency of the "treatment with lime and the treatment without lime would "be at a pressure of from 200 to 250 pounds?*

"A. I HAVE NONE.

"× Q. 111. *So far as your experiments did go you found, "did you not, that the difference in efficiency of these two "treatments diminished as the pressure increased?*

"A. *Not in proportion as the pressure increased, but with an "increased pressure the difference was less.*"

Morton attempts to show tests relevant by bringing in coil.

It was only when depressed by a good many demonstrations of his having been in error that Professor Morton was induced to make so candid an admission of the baselessness of his conclusions, a night's rest brought him back to the stand *himself again*, and utterly incapable of admitting the destruction of a theory by any amount of adverse proof. He had bethought himself of the coil test which he had witnessed, and had a plausible escape from his difficulties. To do Morton and ourselves justice we must ask the court to again read a long extract from his testimony. (Pages 1421–1423.)

"× Q. 180. Please read your answer to Q. 30, master's "record, page 279 (now page 1373), and state whether

"the opinions you there express are still maintained by "you.

"A. In the first place, I notice that there appears a mani- "fest error in this answer; for, on comparing the record "of the experiments made by me at Cincinnati, they show "that the difference in the product obtained by treating "the materials for the same time, with and without lime, "under otherwise identical conditions, was about 12 per "cent.; and therefore this statement, in my answer to "question 30, should be modified by saying, 'a gain of "about 12 to 20 per cent.,' instead of simply 20 per cent., "as it there appears. Otherwise, I think, the answer is "correct.*

"× Q. 181. You did not state in your answer to Q. 30, "nor do you state now, that you are aware that the differ- "ence between the result of the treatment with water and "the treatment with water and lime more nearly approach "each other when increased pressure was used. Do you "not think that this fact should also be stated in connec- "tion with that answer, in view of the fact that the pressure "used by these defendants was, as you know, very much "higher than that used in this experiment?

"A. At the time of giving this answer I had in view only "the process as I saw it carried out at defendants' works, "and which I believed, and do believe, is the process "which they were then using, and have continued to use, "as regards the degree of pressure; consequently, *in* "*stating that answer at that time, I did not contemplate* "*anything beyond this pressure and the result in the manu-* "*facture thereby obtained.*† What would be the result at

*He here considers only the tests at 90 and 131 pounds, completely ignoring the tests at 150 pounds.

†A beautiful example of Professor Morton's tendency to "contem- "plate" one thing and *swear* to another. What he *said* in his answer to Q. 30, page 1373, was, "*It would also appear from my own and all the* "*other experiments with which I am acquainted that the production of a* "*practically thorough saponification without lime or some other equivalent* "*material, or, in other words, by the action of water heat and pressure* "*alone*, CANNOT BE OBTAINED AND NEVER HAS BEEN OBTAINED, EITHER "ON THE LABORATORY OR COMMERCIAL SCALE."

"a higher pressure I am, of course, unable to say; *but,*
"*from the experience which I had at that time with the coil*
"*apparatus, where very much higher pressures were used,*
"*and where, nevertheless, 81 1-4 per cent. of free fat acids*
"*was the best result obtained, I do not think it is at all safe*
"*to infer that the apparent law of decrease in the efficiency*
"*of lime would continue beyond the point at which these ob-*
"*servations reached; in other words, these experiments*
"*with the coil apparatus seemed to indicate that the best*
"*result obtainable without lime, with an enormous pressure,*
"*and even with the development of acroleine, was about 80*
"*per cent.*, while our experiments show that with very
"moderate pressures and the use of lime a result *at least*
"*as good as 95 per cent.* was readily secured.

"× Q. 182. *Did you ever obtain 95 per cent.* in any one
"analysis made by you of any product?

"A. (Referring to table.) *I reached 94.9, which was so*
"*near 95 that, for round numbers, I so stated.*"

What he forgot in framing his theory.

This was a happy thought which Morton seized on the spur of the moment, and it was not only plausible, but logical. *If* at 2000 pounds pressure the products were *the same* as at 131 pounds, it was fair to presume that at 225 or any intermediate pressure they would remain at the same point. But in this instance as in all others, Morton's ingenuity and plausibility were exercised at the expense of, and in defiance of facts.

His own analysis had proved that with water alone at 131 pounds, decompositions of 84.43 and at 150 pounds decompositions of 92 per cent. had already been obtained—facts hard to rconcile with his *theory* that 80 per cent. of decomposition was the maximum of the water process, and which when considered in connection with the results at 2000 pounds indicated very clearly that the tests of the coil were not properly made, and that either the intelligence or the honesty of the experimenters was to be questioned.*

* How a poor product was obtained from defendants' coil we will fully explain further on.

Morton swears that 1 per cent. lime will make difference of 12 per cent. in decomposition.

Before Mr. Morton's confidence in the plausibility of his theory could be shaken by a remembrance of these facts he was asked :—

"× Q. 185. Do you intend to be understood as swearing as "a matter of fact that your opinion is, that had the com- "parative experiments tried by you at Cincinnati been "tried at a pressure of from 200 to 250 pounds, instead "of a pressure of 131 pounds, that there still would have "been a difference of 12 per cent. between the product of "the digester with water alone and a digester with water "and 1 per cent. of lime?"

and after several attempts to evade the question he finally answered :—

"A. I have already stated my opinion as a matter of fact, "and also given you my reasons for it; but if you prefer "the opinion without the reasons, *I will state that I believe, "as a matter of fact, that the difference would be more than "12 per cent. under the conditions named.*"

This astounding assertion was perhaps ventured in the hope that the master or the court might believe it, but that counsel should suppose for an instant that it had any basis of fact the witness could hardly have anticipated. It is, however, greatly to the credit of defendants' counsel that he was able to believe Professor Morton, as it indicates that he was not privy to the fraudulent suppression of the context of Exhibit No. 2, and the influence of Cloetz' test upon the experiments. His credulity, however, while creditable, was the final blow to his case, for he here sprang to his feet and without consulting his "expert" sought leave to *test the truth of his witnesses' assertion.* Record, page 1423.

Defendants' counsel proposes to test Morton's statement.

"Counsel for defendants here moves the master for an al- "lowance of time before the close of defendants' evidence "to enable him to have made, or endeavor to have made, "with all reasonable diligence, a test of the digester pro-

"cess at a pressure of from 200 to 250 pounds, or in "other words, *in all respects in conformity with the descrip-* "*tion of the answer, as to defendants' process used at the* "*time*, with and without the percentage of lime there "mentioned: and states that he was under the impression "that such tests had been made, and feels himself in part "responsible for their not having been made, supposing "his error to have arisen from the fact that having been "informed a few weeks before the tests were ordered "made that the defendants were using exactly the pro- "cess that they were using during the period of infringe- "ment, and having been under this impression through- "out, until the testimony revealed the fact that a change "had been made intermediate between his information "and the making of these tests, that the process was in "all respects identical, he *may*, in directing experiments "to be made, have assumed that the direction to follow "out in every particular the process that they were prac- "ticing was equivalent to the direction to follow the de- "scription of the answer; and *may* have been less explicit "than he should have been, but, because of such im- "pression, in pointing out the fact that 200 instead of 150 "pounds pressure was to be used; and that it is only "since so much prominence is given to this discrepancy "in the cross-examination that it has seemed to him "that there was any occasion for the expense and delay "of repeating the test."

The request of defendants' counsel was of course acquiesced in by complainant and granted by the master. The defendant J. N. Gamble went back to Cincinnati and made the series of seven tests which he described in his testimony (Rec. pages 1424 to 1530), sending duplicate samples to the master, who in turn sent one of each pair to the defendants' expert Morton and the complainant's experts Booth and Garrett. (See the master's statement, page 1430.) We have, however, we may mention here, put no expert testimony into the case, being quite satisfied with the completeness with which the defendants' experts rebutted themselves.

Tests prove Morton wrong, and that lime as used by defendants gave no increase in decomposition.

Professor Morton analyzed the samples sent to him by Mr. Gamble through the master, and the results are described by him in his testimony, pages 1430 to 1436, and tabulated *by him* in the defendants' Exhibit No. 15. (Rec. page 1532.) This tabulation is by the way a characteristic production, for while it gives the figures of his analysis correctly enough, it is as a whole so prepared as to *conceal* some facts—to *misstate* other facts—to *entirely suppress* other facts—and in fact to obscure, hide, and misrepresent the very facts which the tests were intended to ascertain. We will later have occasion to deal fully with this tabulation, but for the present we will take it as it is, calling attention simply to the fact that digestion No. 6 shows that (1) with only half the water the defendants used as stated in the answer; (2) with this half quantity applied in one dose; (3) with no lime; (4) with a treatment an hour less than that of defendants; and (5) the other conditions parallel, a decomposition of 95 per cent. was effected. A product containing 95 per cent. of free acids, the very product referred to by Morton as a type of practical perfection upon which his estimate as made in answer to Q. 30, pages 1372–3, and × Q. 180 to 187 is based, and which in answer to Q. 44 he refers to as the point reached by the old method. (See page 1377.)

Defendant's method as described in answer, page 21.	*July experiment No. 6.*
(1.) Equal quantities water and fat.	(1.) Equal quantities water and fat.
(2.) One per cent. lime.	(2.) No lime.
(3.) Nine hours' treatment at from 200 to 250 pounds.	(3.) Nine hours' treatment at 225 pounds.
(4.) Old water removed and 100 per cent. fresh water added.	(4.) No change.
(5.) An additional hour's treatment.	(5.) No additional time.

That with all the additional disadvantages besides the absence of lime, an hour's less treatment, and but half as much water, the decomposition reached Morton's standard of

practical perfection, is about as complete a refutation of Mr. Morton's testimony and of the theory of the defense as can well be imagined.

A change of water and an hour's additional treatment in digestion No. 6, gave a product showing 99.1 per cent. of free acids, and this analysis disposes finally of the theory that lime had played any useful part in the process used by defendants.* That without any change of water the decomposition of No. 6 could easily have been carried far beyond Morton's standard of 95 per cent. even to the point of chemical perfection is clearly apparent. A little more heat—a little more time—a few additional pump strokes—any one of these changes would have done it, and any one or all of them might be used without appreciably increasing the cost of the operation.

Here then in the July tests we have the end of the defendants' case.

Summing up.

When we entered upon this branch of the case we showed that there could be no defense to our claim that the defendants should account for their *chemical savings* the lime and acid, except upon the theory that highly heated liquid water would not, and could not, effect a *practically good* decomposition of fat. That if water alone would and could accomplish this, then all that *could be* effected by improvements and modification of the complainant's process were savings or gains in the items of labor or fuel, for those, in effect, are the only things left which cost money.

We showed the court that the defendants fully appreciated this position, and based their defense *solely* on the theory that water alone *would not* effect a practicably thorough decomposition.

We have followed the defendants' experts through their

* We mention this simply to illustrate the completeness of the overthrow of the defendants' case. Having reached the standard of *practical perfection* set up by the defendants there would of course be no object in carrying on the process to the extent of a chemically perfect decomposition.

elaborately planned schemes and cunning plots, and have demonstrated,

That so far from there being no evidence in the old record as to the practicability of the water process as they pretended, there is the most overwhelming proof, the most absolute certainty from the evidence and facts that the water process was not only successfully used, but was used to greater advantage than with the alleged modifications of the use of a little lime, and the double using with water—

That so far from there being in the literature of the art a general condemnation of the water process, there was even in the poor four instances which the experts cited, no such assertion, and in one of them there was a full description of a test experiment with water alone which yielded the most perfect fatty acids, and a full explanation of the *only causes* which would in any case account for a poor product from this process; and—

That their pretended tests were made under the very conditions, so carefully explained in Wagner, as the only ones which *could* yield a poor product by the water process, and had no relevancy to the defendants' use, or indeed to anything but the conditions of failure as Cloetz demonstrated them. That these tests even did not support the statements of the experts concerning them, and that every theory and assumption of the defense was swept away by the July tests at 225 pounds pressure.

In short we have, *without* a word of *rebutting testimony*, drawn from the defendants' experts and the matter in the record which they claimed to be familiar with, a full and complete demonstration of the perfect practicability and excellence of the water process, and shown that the whole theory of defense was conceived and presented in either the grossest and most inexcusable ignorance or in deliberate fraud. That it was all fraud or all ignorance we do not mean; neither would alone account for the foolishness of the defendants' attempt, and it was only by imposing ignorance upon fraud that the defendants' plan of defense could have been conceived.

The practicability of the water process being now settled, there would seem to be little use in following Professor Morton through his really brilliant attempts to raise new issues which would lead the master and the court away from the one on which he and Dr. Endemann had brought the defendants to such utter grief, but as the master was misled by them, and embodies in his report findings based on such errors, it will be necessary for us to follow Professor Morton quite closely on some of his new inspirations. Before going after Morton, however, we will here call attention to our *fifth* and *sixth exceptions*, the errors assigned in which are purely the master's own.

THE MASTER'S ERROR IN REPORTING THAT THE USE OF THE COMPLAINANT'S PROCESS BY MITCHELL WAS NOT COMPETENT EVIDENCE IN THIS CASE, AND THAT THE SAID PROCESS HAD NEVER BEEN REGULARLY USED IN SUCH APPARATUS AS THAT OF THE DEFENDANTS. EXCEPTIONS NOS. 5 AND 6.

What the Master reported.

The parts of the report to which our fifth and sixth exceptions are directed are printed, beginning at the bottom of page 1200 to about the middle of page 1202. He begins by saying:

"Respondents cannot be charged with any advantages they "might have realized by use of that *process* otherwise "than as they in fact used it."

Which is perfectly true. He continues, however, by basing on this premises the finding that—

"Neither is it material in this case whether the Wright & "Fouché *apparatus* used by Mitchell & Co. had yielded "a superior product."

And so dismisses Mitchell's use of *the process* from the case, and closes his eyes to the facts as to the capability of the water process, which are so fully demonstrated by the Mitchell use and the Cloetz experiment.

Why Mitchell's use should be considered.

We never dreamed of asking the master to estimate the defendants' savings on the basis of Mitchell's use. What we did

ask him to consider was the fact that Mitchell and Cloetz using the Tilghman process without either lime or a second dose of water, the two alleged modifications of it used by defendants had obtained perfectly decomposed products, and that therefore these modifications were not, as Morton and Endemann asserted, essential or necessary.

Mitchell's and Cloetz's use was relevant in the same way and to the same degree as were the July tests, and can no more be ignored than can these tests themselves. When we say that even Endemann and Morton did not venture to suggest that these uses could on any theory be ignored or distinguished from defendants' use except in the fact that they did not embody these two modifications, it will be apparent how far the master's distinction was from common sense.

Defendants' experts acknowledge Mitchell's use to be relevant.

When Mitchell's use was brought to Endemann's attention he could, your Honors will remember, think of no other way to escape from its crushing effect upon the defendants' defense than to boldly deny that it had been successfully used (see pages 1285–7). He admits that the use was a use pure and simple of Tilghman's process without "modification" (page 1286).

"× Q. 111. In the process carried on in the Wright & "Fouché apparatus, as described in the record, are not "heat, pressure, and water alone the efficient agents in "decomposing the neutral fats into fat acids and glyce- "rine?

"A. *I consider, as the efficient agents in the Wright & Fouché "apparatus, merely the water at high temperature.* The "pressure I consider a necessary inconvenience, and of "value so far as it would tend to keep the water in a "liquid state."

Defendants' and Mitchell's apparatus practically identical.

The only difference between the apparatus used by Mitchell and Cloetz and that of the defendants is in the external form of their digesters. They are both closed boilers, working at high pressure and provided with a mixing device for drawing water from the bottom and spreading it on top of the fat, and the processes carried on in them are identical

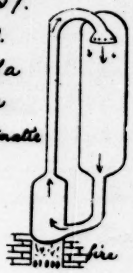
Apparatus of the kind used by Mitchell and others in decomposing fats by Mr. Tilghman's process. Also similar apparatus in use in the arts for analogous purposes prior to 1854.

(see Compt's Exhibit No. 23. p. 1561)

Apparatus used by defendants (Mitchell) Wright & Foushé's Pat. 1857.

Fig. 10.

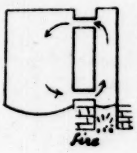
The ascending power of a column of heated water causes a continuous automatic circulation.



Apparatus commonly known and used before 1857. Figs. 11, 12, 13, 14 and 15.

Hoyd. 1795. Fig 11.

The ascending power of a column of heated water causes a continuous automatic circulation



Ures Dict.ª 1839. Fig 12

A column of heated water and steam ascends and causes a continuous automatic circulation

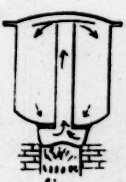


Fig. 13.

Dict: de l'Industrie 1834.

A column of heated water and steam ascends and causes a continuous automatic circulation

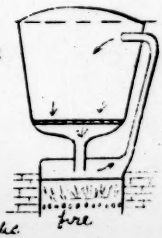
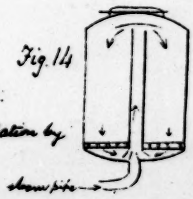


Fig. 14

Mather 1853.

Heat and circulation by a jet of steam



Apparatus of the kind used by defendants and others in decomposing fats by Mr. Tilghman's process. Also similar apparatus in use in the arts for analogous purposes prior to 1854

(See Compt's Exhibit No. 23. p. 1561)

Apparatus used by Pltf. licensee. C.T. Jones

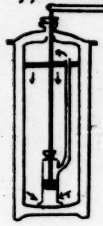


Fig 6

Vertical boiler with pump to draw water from bottom and spread in on top in a shower of drops.

Apparatus commonly known and used before 1854. Figs. 7, 8, and 9.

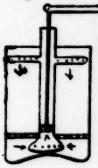
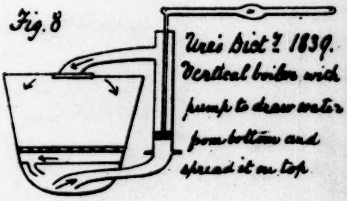


Fig. 7. Berthollet. 1824.

Vertical boiler with pump to draw water from bottom and spread it on top in drops

Fig. 8



Ure's Dict.y 1839.

Vertical boiler with pump to draw water from bottom and spread it on top

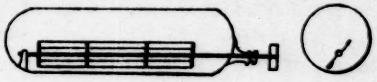
Fig. 9. Alliott. 1851.

Vertical boiler with centrifugal pump to draw water from bottom and shread it on top.

Apparatus of the kind used by Wilson, Roper & Grant in decomposing fats by M'Tilghman's process. Also similar apparatus in use in the arts for analogous purposes prior to 1854.
(see compl's Exhibit No. 23. p. 1561)

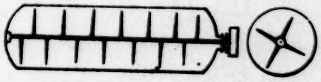
Apparatus used by Pltf's licensee & Ropes
Horizontal boiler with rotating paddles

Fig 1.



Apparatus commonly known and used before 1854.
Figures 2, 3, 4 and 5.

Horizontal boiler with rotating paddles.
Fig. 2
Morfit.
1841.



Horizontal boiler with rotating paddles.
Radley & Meyer
1851.
Fig. 3.

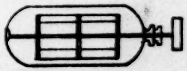
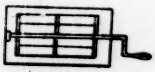
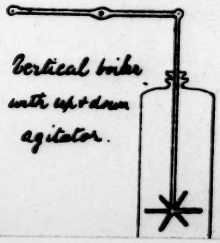


Fig 4.



common barrel
Churn.

Fig. 5. De Melly 1834.



Vertical boiler
with up & down
agitator.

except that Mitchell and Cloetz used no lime and but one charge of water. The only difference between the Wright & Fouché digester and the defendants' digester is in the build of pump used for securing an intermixture of the fat and water; both pumps, however, operate in the same way, and are in the narrowest sense mere mechanical equivalents, and both were well known as such long before the date of Tilghman's patent (see Complainant's Exhibit No. 23, Record, page 1561). In this exhibit Fig. 10 illustrates the Wright & Fouché digester, which is exactly the same as the digester shown in Fig. 11, dating from 1795, and substantially identical with the digesters Fig. 12 (1839), Fig. 13 (1834), and Fig. 14 (1853). On the other side we have Fig. 6, the defendants' digester, substantially the same thing as is shown in Fig. 7 (1824), Fig. 8 (1839), and Fig. 9 (1851). The selection of one of these pumps rather than the other is exactly the same sort of choice that a man exercises in buying a pump from one maker rather than from another.

To hold that Mitchell's case was not relevant because his pump was not of the same kind as defendants', is no more reasonable than if the master had ruled it out because he used Croton water while defendants took theirs from the Ohio.

Comparison of processes used by defendants and by Mitchell.

Now, before continuing the examination of the master's report, look at the relation of the *processes* used by Mitchell and by defendants.

Mitchell.

(1.) Mixed fat and water in a closed boiler.

(2.) Using water equal to ⅔ of the fat.

(3.) At a pressure of 180 pounds.

(4.) For eight or nine hours.

Defendants.

(1.) Mixed fat and water in a closed boiler.

(2.) Using water equal to the fat.

(3.) At a pressure of 225 pounds.

(4.) For eight and one-half hours.

(5.) Then renewed the water and continued the digestion for an hour.

(6.) 1 per cent. of lime being used with the fat.

Note 1.

(1) The facts as to Mitchell's use will be found in Verdin's testimony as follows:—Page 160, Q. 128; page 164, × Q. 160, and page 184, Q. 41.

Note 2.

(2) In their answer defendants state that they used two charges of water, each equal in bulk to the fat. Mr. Gamble, however, in his testimony says he thinks that each charge was equal to only half the bulk of the fat, page 1428, Q. 2. It makes little difference, however, in this comparative statement.

Evidence cited by master, less revelant than Mitchell's use.

Yet the master, rejecting Mitchell's use, turns to the old record and industriously hunts up the witnesses produced in the Werk case to find instances of pretended difficulty in operating without lime. He cites Grant and Ropes, whose digesters differed much more radically from the defendants' than does Mitchell's, inasmuch as they used no pumps at all, and effected the necessary mixing of fat and water by a revolving paddle (like that shown in Complainant's Exhibit No. 23 in Fig. 1), and who used a pressure far lower than either defendants or Mitchell, and refers to Jones and Cornwall, both of whom obtained perfectly good decompositions with water alone, but preferred to work at lower pressure and use a little lime.

Evidence as a whole demonstrates perfect practicability of water process.

If the Grant, Ropes, Jones, and Cornwall uses were as the master reports, it would require but little mental effort to understand that they simply weighed the expense and trouble of keeping up a pressure of say 250 pounds against using a pressure of 150 or 170 pounds, with the added expense of a pound of lime and 3 of acid per cent.* A matter of small moment either way, and relating entirely to the manufacturing economy as distinguished from the chemical economy of the process.

But if the record had a dozen instances of the non-success of the water process, instead of not having one, they are amply explained by Cloetz and should have been disregarded in view of a single successful use such as Mitchell's, which demonstrated that the non-success of any test was due not to any inefficiency of the process, but to some disregard of its requisite conditions, viz. *sufficient mixture—sufficient heat—sufficient time.* The importance of each of which conditions is fully set forth in the patent.

*As we show post, pages 119, &c., a few additional pump strokes per minute would have enabled them to dispense with any lime, but naturally they were well enough satisfied with the great saving of 13 pounds of lime and its equivalent in acid, and were not looking closely to trifling details of manufacturing cost.

FALSE ISSUES RAISED BY DEFENDANTS AFTER THEIR DEFENSE HAD BEEN BROKEN DOWN.

Besides his mistakes as to glycerine, which we will leave until the subject of the lime and acid savings is exhausted, the rest of the errors which the master embodied in his report were based on Morton's clever strategy in raising false issues after the annihilation of his case as presented before the July tests.

Professor Morton resumed his testimony (page 1432), by putting in evidence the table Defendants' Exhibit No. 15 (page 1532), and giving an account of his analysis. Now, these July tests considered in connection with Mr. Gamble's testimony are a most beautiful and complete demonstration of the conditions of success in the water process, of its perfect practicability, and of the part which a double dose of water or the use of a little lime may have in the working of the process, and by this time Professor Morton must have learned enough about the decomposition of fats to have understood and appreciated their full meaning. Therefore it could no longer be ignorance which led him in preparing his table to state falsely some of the facts, and to suppress entirely other facts which were vital to a clear understanding of the results of the experiments.

Confusion, misrepresentations, and suppressions of fact, in Mortons' tabulation of the July tests.

These tests, it will be remembered, were undertaken by defendants to prove the truth of Morton's statement that when working at 225 pounds with exactly similar conditions to the defendants' usual method, except as to lime and using the water in two doses, the water process would show a decomposition at least 12 per cent. below 95 per cent., which he had previously assumed as practical perfection; and of his other statements, to the effect that the efficiency of the water pro-

cess was limited to a decomposition of but little over 80 per cent.

Now, to begin with the least of Morton's misdealings with these tests, we will instance his burying the analysis of the final results of the treatment of the different charges under a mass of analyses of samples taken during the earlier stages of the treatment, and marking the hours when the samples were taken by letters instead of numbers. The result of which is that, so far as the table shows, one analysis is as much in point as another, and you must *refer to Morton* for an explanation.

Next, he marks on each digestion the quantity of water used, *but not truthfully*. He marks digestions 3 and 4 as each made with charges of water equal to 50 per cent. of the fat, while in fact No. 3 had but 45.20 per cent. of water, against 50.37 per cent. in No. 4; *a difference of over 10 per cent.*, and he marks digestion No. 7 as having been made with 100 per cent. of water, whereas in fact it had but 89.77 per cent., or over 10 per cent. less.

Next, he says *nothing* about the way the pump was working in the different tests, a fact which of course goes to a most vital point—the perfection of the intermixture of fat and water—and which Mr. Gamble carefully explains. The facts being that in No. 1 the pump was going at times but 10 strokes a minute, and never over 13 strokes; in No. 2 it went as low at times as 12 strokes, reaching 14 at other times; in No. 3 Mr. Gamble says it was only observed twice and then was going at the rate of 14 strokes; in Nos. 4 and 5, *the lime digestions*, it was going at an even rate of 14 strokes; in No. 6 it was 14 strokes, and in No. 7 it was but 13 strokes.

Next, he does not give the quantity of fat in each digestion; and—

Finally, he does not refer to the fact that of the analyses of digestion 4 and 5 were of a mixed product, 10 per cent. of which was always lime soap and not fat acids as the analyses indicate. The annexed tabular statement will enable the court to see at a glance the true results of the July tests and to compare them with Morton's table.

Morton's testimony after July tests.

Professor Morton, having substituted his table for the facts, was ready to be questioned about the conclusions which he drew from the July tests, and on page 1436 he was asked:

Analysis of Morton's Answer, No. 191.

The answer.

"Q. 191. How, *if at all*, are the "opinions heretofore expressed by "you as to the relative efficiency "of the Tilghman process (I mean "the Tilghman process unmodi- "fied, except in respect to mech- "anism and degree of pressure) "and the process used by the de- "fendants affected by the results "of the analyses or other investi- "gations made by you since the "adjournment of July 4th?

"A. I have made no investiga- "tions on this subject since the "date you have mentioned, but "have, of course, made a number "of analyses of the products ob- "tained by Mr. Gamble, and *the "results of these analyses seem to "me to support in a very remark- "able way many of the opinions "which I have already expressed "as founded on previous experi- "ments made by myself or others.*

"Thus I have stated before that "in the process as carried out by "the defendants, I considered that "the 1 per cent. of lime em- "ployed was a most efficient factor "in the production of the result "obtained, and this opinion I find "confirmed in the most marked "manner by these analyses.

"Thus, if we compare together "series Nos. 2 and 4, *which, as I "understand, are alike in their "conditions, except that in No. 2, "no lime was used nor was the "water changed, while in No. 4*

Comment.

Now we will see why the table was doctored, and how a professional expert can escape from facts which oppose him.

Quite true! they do afford the most "remarkable *support*" for the witnesses' assertions that could be imagined.

He stated that without the 1 per cent. of lime, water could not bring the decomposition to within 12 per cent. of 95 per cent. under *any* conditions.

Simply *false*, he *knew* that the digestions were unlike in the additional fact, that the mixture in No. 2 was much less thorough than in No. 4, and he does not make the fact very clear that there was not

Analysis of Morton's Answer, No. 191.—Continued.

The answer.	*Comment.*
"*1 per cent. of lime was used and* "*the water was changed* between "the times when samples J and K "were taken. We shall see, in the "first place, that in a single hour "where the lime was present about "65 per cent. of free fat acid was "developed, and that in three hours "91 per cent. of free fat acid was de- "veloped, which was only reached "in the process of 2, where no "lime was present, at the end of "eight hours. In fact, where the "lime was absent and no change "of water occurred, at the end of "nine and one-half hours only 91.5 "per cent. of free fat acid had been "obtained, and the fact that only a "variation of 1 per cent. occurred "in this experiment from the sev- "enth hour to the end of the oper- "ation, seems to me to *indicate* that "with the conditions then existing "no appreciable increase in the "yield of fatty acid would have "been obtained in any reasonable "time.	only a change of water in No. 4, but a use of *double as much*.
"Even where a much larger "quantity of water was used, as "in experiment No. 1, where 80 "per cent. of water in place of 50 "was added, the final result is "practically no higher.	This "indication" was even more marked in the digestion with lime where no appreciable change occurred from the third to the ninth hour.
	This is simply outrageous; *he knew*, from digestions 6 and 7, that an increase of water would show a great increase in fatty acids, other things being equal, and *he knew* that the reason No. 1 showed *a lower* decomposition than No. 2 was because the mixture was much less. "Practically "no higher," is his way of stating that it was *1 per cent. lower*, when this fact would call attention to his fraud.
"It would also appear that *under* "*the conditions of the patent as to* "*the amount of water employed*,	The "conditions of the patent "as to the amount of water" is a new idea implying that as the de-

Analysis of Morton's Answer, No. 191.—Continued.

The answer.	*Comment.*
"and the conditions of time and "pressure stated in the answer, the "product produced would have "contained AT THE BEST UNDER "92 PER CENT. OF FREE FAT "ACID.	fendants use more water than is suggested for high heat, they have got ANOTHER "MODIFICATION." But "AT BEST UNDER 92 PER CENT." is, in view of the fact that in digestion No. 3 with *less water*, and an hour's *less time* his own analysis showed 92.3 per cent. simply false.
"Such a product was *notably* "inferior in purity, and, therefore, "*manifestly* less valuable than "that obtained by older processes. "To bring the product from this "condition up to one in which its "purity would be *equal to that of* "*the product obtained by older pro-* "*cesses* it would appear that a "change of water is *absolutely* "*necessary*, together with the aid "of lime."	Morton had his hand well in when he got as far as this statement. He holds us to 50 per cent. of water, because digestion 6 shows that an increase will tell in the digestion, but, by referring to No. 1, he tries to give the impression that even an increase of water will not really help. He states that with 50 per cent. water the decomposition is "at best *under* 92 per cent., knowing that with less water and less time the result was actually over 92 cent. He states that the aid of lime is necessary when his analyses show there was nothing for it to do, *and he says the products of the old processes were* NOTABLY *purer and* MANIFESTLY *more valuable than such a product*, not to mention his assertion that a change of water was *absolutely* necessary. Now the great fact demonstrated in the July tests is the wonderful increase in the decomposing power of water which follows each approximation to the condition of emulsion or thorough mixture recommended in the patent. And Morton knew that so far from its being "absolutely necessary" to change the water, that a fewer additional pump strokes would make the old water do as

Analysis of Morton's Answer, No. 191.—Continued.

The answer.

"These analyses seem to show "that this change of water had "the effect of increasing the free "fat acid in the product by from "4 to 5 per cent., *wherever such "increase were possible without "getting beyond 100 per cent.* "Thus, in series No. 3, the change "of water increases the fat acid by "4 per cent.—that is, from 92.3 "to 96.4; in No. 4 it changes it "just 5 per cent. from 92.7 to "97.7; in No. 5 the change of "water only raises the fat acid 2.6, "from 96.7 to 99.3, but it is mani- "fest that having got to 96.7 there "was not room enough for a 5 "per cent. addition. In series 6 "the change of water causes an "increase of fat acid of about 4 "per cent.; here again, however, "the result approaches close to "the possible limit. In No. 7 the "increase produced by the change

Comment.

well, a fact shown not only by the tests but by Mitchell's better use of his pump, giving perfect results at 45 pounds less pressure.

Another thing was proved by the old and new tests together, viz., the rapid increase in the power of water with the increase of the heat, and Morton knew that a few pounds more pressure would give the same results as the "absolutely necessary" change of water.

But these are but trifles to the statement of the witness as to the perfection of the old process products which here for the first time assumes an aggressive form. He had formerly estimated it in a general way as about 95 per cent.

—

"Wherever such increase were "possible *without getting beyond "100 per cent.*" A thoroughly Morton-like mode of stating the fact that the proofs showed that perfect decomposition could be obtained without changing the water.

—

Analysis of Morton's Answer, No. 191.—Continued.

The answer.

"of water is about 4 per cent. "in this sample, also the product "having reached 94.7 per cent. "prior to the change of water."

"The remarkable action of lime "in facilitating the saponification "is also strongly shown if we "compare samples D, obtained at "the end of the third hour, in di- "gestions 2, 3, 4, and 5, 2 and 3 "being without lime and 4 and 5 "with. In this case, without lime, "at the end of the third hour, we "obtained in one case 56 and in "the other case 51 per cent. of free "fat acid, and with lime 91 and 93, "*an increase of more than 50 per* "*cent.* on the amount obtained "without lime."

"Another curious effect exhibit- "ed by these results is the fol- "lowing: Where lime is present "it would appear that almost the "maximum result, especially where "the amount of water was 50 per "cent., is obtained at the end of "the third hour, and that after this "the subsequent digestion seems "to have little or no effect. The "small fluctuations, for instance, "which are shown in series 4, be- "tween sample D and sample J, "I should regard as being with- "in the limit of error in such a "method of analysis, or very near- "ly so, and that these results show "a practical identity between the "sample taken at the end of the "third hour and that taken at the "end of eight and a half hours. In "the sample in series 5, where the "amount of water used was equal "to that of the quantity of the fat, "there is a gradual increase, *amount-*

Comment.

Another striking instance of Professor Morton's uncontrollable propensity. "An increase of *more* "than 50 per cent." Why, the man's own figures, scarcely out of his mouth, show that the increase he is referring to was as 91 minus 56 or 35 is to 90, viz., exactly 38.42 per cent.

Amounting *in fact* to exactly

Analysis of Morton's Answer, No. 191.—Continued.

The answer.

"*ing in all to about 3 per cent.*, be-
"tween the sample taken at the
"end of the third hour, and at the
"end of eight and a half hours."

"But, in any case, it would seem
"from the result of these analyses
"that, where lime was used, *if* the
"process had been carried out for
"three hours, the water then
"changed, and the action continued
"for perhaps an hour more, a practi-
"cally perfect saponification *would*
"*have* been secured—that is to say,
"one of 99 per cent. free fat acid,
"and, therefore, that in this case
"the addition of 1 per cent. of lime
"*would have* reduced the time
"to one-half. Or, again, if we
"compare the digestion No. 4 with
"digestion No. 2 we see that where
"the lime was present the result of
"91 per cent. free fat acid was ob-
"tained at the end of three hours,
"and without lime, in series 2, at
"the end of eight hours; therefore
"the efficiency of the lime as thus
"shown, or its capacity of effecting
"saponification *under conditions*
"*otherwise identical*, is expressed,
"I think, by this time relation
"of 3 to 8—that is, it could do in
"three hours what otherwise re-
"quired eight. Or if we look upon
"the process as a process of effect-
"ing something, the 1 per cent.
"of lime doubles the efficiency of
"the general process of effecting
"this saponification. It is true that
"in the process used by respond-
"ents at the time referred to the
"heating was continued after 91
"per cent. of free fat acid had been
"obtained, *with no practical effect*
"for five and one-half hours more

Comment.

$3\frac{7}{10}$ per cent., which is more "*about*" 4 than 3 per cent.

"If" the defendants had been governed by Morton's theories, instead of practical experience, who can tell what they "*would have* se-
"cured," or how long it "*would*
"*have*" taken them to secure it? Probably bankruptcy in a remarkably short time. It will be remarked that they did not *again undertake to test the truth* of his hypothesis.

It must be acknowledged, however, that Professor Morton shows great skill in substituting an ingenious theory as to a hypothetical process for the facts as to an actual use.

Analysis of Morton's Answer, No. 191.—Continued.

The answer.	*Comment.*
"—in other words, the lime having done the work in three hours, "the water, under pressure, had "nothing to do, and accomplished "nothing in the remaining five "hours, and the final pure product "was obtained by the additional "action of the changed water."	
"*These results, looked at in this "way*, seem to me to support what "I have previously said as to the "great importance of those modifications of the Tilghman process "involved in the use of lime and "the changing of the water, which "constitute the distinguishing characteristics of the process *as used* "by respondents.	How neatly he transfers his conclusions as to the results which "would have" been secured "*if*" his hypothetical process had been used, to the process "*as used*" by defendants. "These results, *looked "at in this way.*" A pregnant limitation. By ignoring, falsifying, and confusing the *results*, as Professor Morton does, they can of course be made to support any theory.
"In certain respects my previous "impressions have not been *fully "sustained*, and I will proceed to "point these out. It was my opin"ion, from the experiments which "I had made, or of which I was "cognizant, that it would be im"possible, by the action of heat "and water alone, at any pressure, "to get a better result than was ob"tained in the experiments which "I witnessed at Cincinnati with the "coil apparatus, where so very "high a pressure and heat were "used. But these results show "that, *with the amount of water "mentioned in the patent*, as good "a result as 91.5 per cent. of free "fat acid in one case, and 92.3 in "another could be obtained with"out the use of lime or change of "water, where the pressure was "carried up to the point of 225	"Not been *fully sustained*" is a neat way of stating the fact that his testimony has been completely *disproved*. His happy thought of limiting complainant's process to the "amount of water mentioned in "the patent" enables him to ignore the 95 per cent. decomposition obtained with water in eight and a half hours, and his constitutional (or perhaps it is professional) tendency is fitly illustrated by his concluding his reference to the tests with the statement that the result showing 92.3 per cent. was the result of nine and a half hours treatment, when as *he knew*, it was the result at eight and a half hours."

Analysis of Morton's Answer, No. 191.—Concluded.

The answer.	*Comment.*
"pounds, in a closed vessel with "a stirring apparatus, and was *so* "*maintained for nine and a half* "*hours.*	
"But as I have already explained, "*I do not consider such a product* "*as coming up to the requisite* "*standard of purity in a material* "*to be employed for the manufac-* "*ture of candles at the date of the* "*patent.*	"The *requisite* standard of pur- "ity in a material to be employed "for the manufacture of candles "at the date of the patent." Of course the product of lime saponi- fication.
"Those are the only points that "now occur to me, though there "may well be others which I "should realize on carefully read- "ing over my testimony."	

The above partial analysis of Morton's 191st answer will enable the court to understand something of the character of his testimony. It is physically impossible to follow him through all of his testimony in the same way, for in almost every answer there are included the same kind of confusion, evasions, suppressions, misrepresentations, and false statements, which permeate and form the framework of his 191st answer. We have chosen this answer for analysis because it involves either directly or indirectly the false issues which misled the master to our hurt.

The new issues which Morton attempts to bring into the case.

In brief, Morton seeks:—

First.—To substitute for the old and true issue, viz., *the capacity of the water process to effect a practically thorough decomposition of fats*, the new issue—that at the temperature and time used by defendants the water alone would not have given as good results as did the "modified" process—hence that the lime and double dosing were necessary and essential, and even this proposition depending on the limitation of the water process to 50 per cent. water, and of course ignoring the proofs (*a*) that a few more pump strokes

would have brought the charge with water to an equality with that of the "modified process," and (*b*) that a few pounds additional pressure would also have the same effect.

Second.—To set up a standard of chemical purity with which to compare the *results* of the July tests ("looked at "of course in this way") and assume that the old lime process attained this standard.

THE MASTER'S MISTAKE IN REPORTING THAT THE USE OF LIME AND OF THE DOUBLE DOSE OF WATER WERE EFFICIENT MODIFICATIONS OF THE PROCESS OF COMPLAINANT.

He disregards the true and accepts the false issue.

The master has looked at the July tests in Morton's way, and has besides sought to lend strength to this way of looking at them by his finding (already reviewed) that all testimony as to successful use of the water process is to be ruled out as irrelevant, and all testimony as to its insufficiency is to be considered without regard to its conditions, reason, or explanation. In brief, he rejects utterly the most conclusive proof, and for the mass of truth, mistake, and falsehood which remains he can find no better use than to *average* them, forgetting that truth cannot lie midway between a proven fact and a proven lie.

We must ask the court, therefore, if it deems that these secondary issues can have any relevancy to the account, to examine the July tests in the light of truth and not in Morton's way.

REVIEW OF THE EVIDENCE IN DETAIL.

Object and nature of evidence cited by Master from main case record.

The testimony in the main record, to which the master refers on page 1202 of his report, was introduced by the defendants for the purpose of proving that water alone would not decompose fats under the conditions of the patent. In each case mentioned by the master, and in a number of other cases, it

was proved that a number of witnesses had heated water and fat together under various conditions as to heat, time of operation, and perfection of intermixture, and that they had not obtained as good a decomposition as they had under certain other conditions, among which the presence of a little lime was one of the differences.

Essential requirements of complainant's process.

Now Mr. Tilghman's patent, as interpreted by this court is for a process, the essential conditions of which are as follows: *First*, an intimate and continuous intermixture of the fat and water; *Second*, the heating of this mixture under pressure; and it is pointed out in the patent that the rapidity with which the decomposition of the fat takes place, depends on the degree of heat to which the mixture of fat and water is subjected. And it has been abundantly proven in the case, that any neglect of the patentee's instruction as to the intimacy of the mixture, is also accompanied by a great falling off in the rapidity of the decomposition.

Conditions of process to some extent interchangeable.

Each of these essential conditions, to wit: Duration of treatment, perfection of intermixture, and degree of heat may, to a certain extent, be replaced at the expense of the others. For instance, Mr. Tilghman in his patent points out and recommends as in his opinion the best conditions under which his process can be operated, the following, viz.:—

Conditions recommended by patentee.

A perfect intermixture known in the arts as an emulsion.

A temperature of about six hundred degrees.

A treatment under these conditions for about ten minutes.

And he describes in his patent a well-known form of apparatus in which these conditions could be safely and practically produced and carried on.

Why modified in practice, and with what result.

(*a.*) *Temperature.*

When he came to introduce his process to manufacturers, he found that they were fairly terror-struck at the idea of such

pressure, and seeing that this ignorant prejudice (for such it is) would prevent the adoption of his process in its most perfect conditions, he allowed them to put it in at whatever pressure they were willing to use. (See Mr. Tilghman's testimony, pages 1152–3.) The temperatures adopted were from three hundred and sixty-seven to about four hundred degrees Fahrenheit. The defendants in this case, using the temperature of about four hundred degrees, as a result of which they found it necessary to continue the treatment for ten hours instead of ten minutes.

(*b.*) *Intermixture of fat and water.*

Now the mixing device of the defendant's apparatus, which was designed and erected for them by the complainant, is a very good one, and, if used *properly*, will produce a very thorough intermixture of the fat and water. It carried out the requirement of the patent in this respect as well, probably, as can be conveniently done with the form of the apparatus used.

Neglect of patentee's directions as to intermixture fully explains pretended failure of process.

Clear as this patent is, as to the vital necessity of this intermixture, it being, as Justice Bradley says in his opinion, "a "*sine qua non* in the operation," these defendants, both in the main record and before the master, have produced evidence, both oral and documentary, showing that good, practical decompositions could not be obtained by heating fat and water together under pressure, *but without intimate intermixture.*

Baujard's evidence.

Thus the defendants examined before the master one Edmund Baujard, who testified that he was familiar with "the process of saponification by water" as it is carried on in France, where, the pressure used being 225 pounds, the same as the defendants', the products of the process were greatly inferior to the products of the process in which, besides water, there was present 1 or 2 per cent. of lime. Now this witness was examined *after* the July

experiments, and this was an attempt on the part of the defendants to obscure their meaning and mistify the court as to the result of these experiments, to which they themselves had appealed for a determination of the issue; a few words of cross-examination pricked and dissipated this bubble, for it appears that in the process, which the witness called "the "water process," *there was absolutely no "mixing device" whatever for the fat and water.* (Rec., page 1476, × Qs. 39 and 40.)

Again, then, the defendants only succeeded in proving the essential character of Mr. Tilghman's directions in his patent, and that none of them can be neglected without material injury and impairment of the efficiency of the process. The failure of a method of decomposing fats in which there is no intermixture of the fat and water has no more bearing on the question of the efficiency of the complainant's process than the failure of another method in which there is no water used would have.

Importance of Intermixture shown by July Tests.

The vital importance of the condition of intermixture is nowhere better shown than in the results of the July experiments, which, however, the master finds no better use for than adding them up and averaging them.

Apparent anomaly in tabulation of tests.

We have already seen in comparing digestions No. 3 and No. 6 of Morton's table, "Defendants' Exhibit No. 15," that an increase in the proportion of water used, resulted in an increase in the percentage of decomposition in a given time; other conditions being equal; but when we compare digestion No. 1 with digestions Nos. 2 and 3 as shown by this Exhibit, it would appear that the presence of 60 per cent. more water in digestion No. 1, so far from increasing the percentage of decomposition, actually resulted in a smaller percentage. This peculiarity is much more prominent in the earlier stages of the digestion than it is at the time it was stopped; at the third hour, for instance, digestion No. 1 shows but twenty per

cent. of decomposition as against 50 per cent. in digestion No. 2.

Explained by unnoted fact as to intermixture.

Just here, it is, as we have already explained, that this tabular statement of Morton's is a fraud and a delusion. He notes on his table that this digestion No. 1 was without lime; he notes that it was with 80 per cent. of water, and he notes that the water was introduced in a single dose; all of which facts he got from the testimony of Mr. Gamble, but he does not note another fact stated by Mr. Gamble, and which fact explains why this digestion was less perfect than the apparently parallel digestions Nos. 2 and 3, which were made with 60 per cent. less water. Now the fact which Mr. Gamble states with regard to this digestion, is, that while it was being made, *the speed of the pump was slower* than it was in any other digestion.

Gamble, page 1426.

Digestion No. 1, only relevant as to the importance of intermixture.

Mr. Gamble took three observations of the pump speed during this digestion, finding it during a part of the time to be *but ten* strokes a minute, and *at highest, but thirteen* strokes per minute, while in digestion No. 3, it had an average speed of *fourteen strokes* per minute. In other words, *the intermixture in No. 1, was very much less perfect than in No. 3*, and although Mr. Gamble does not point out when his observations of pump speed were taken, the table of analysis indicates very clearly that its lowest speed was at the beginning of the digestion. This digestion No. 1, then, although of great importance as showing the essential nature of the patentee's directions as to mixture, is not a parallel experiment with any of the others, and is no more to be added up and *averaged* with them, than are Mr. Baujard's digestion, in which there was no intermixture whatever.

Digestion No. 2, also useless for comparison because of irregular pump speed.

In digestion No. 2, also, the pump speed was irregular, and

less than in any digestion except No. 1, so that this digestion also is wanting in that parallelism which would make it proper to compare with the others.

Pump speed regular only in digestions 3, 4, 5, and 6.

It is only in digestions Nos. 3, 4, 5, and 6, that the pump speed was kept at the same rate in all; namely, fourteen strokes per minute.

But other irregularities giving unfair advantage to digestions with lime.

But even in these two pair of experiments perfect parallelism was not maintained, and its absence in each case was in favor of the digestion *with lime;* for instance, Prof. Morton's notes of digestions Nos. 3 and 4, that each was with 50 per cent. of water; this is not so. Mr. Gamble states in his testimony that digestion No. 3 was made with charges of water equal to but 45 per cent. of the fat, while digestion No. 4 was made with water equal to 50 per cent. of the fat. That is, there was a difference of 10 per cent. in the amount of water used in favor of the digestion with lime as against that without lime; and, moreover, there was in digestion No. 3 230 pounds more fat to decompose than there was in digestion No. 4. Gamble, page 1427.

As between digestions Nos. 5 and 6 there is this difference: the charge in digestion No. 5 was actually in the digester and exposed to the action of the water to a greater or less degree for an hour longer than digestion No. 6. Gamble, page 1427.

The horizontal line of analysis A shows the condition of the fats before digestion. It will be noticed that the free fat acid in the samples is constant for digestions 1, 2, and 3, *much* larger in digestion 4, and somewhat larger in digestion 5. This free acid indicates the state of rancidity, in which the fat used was, and the analyses show that the fat used for the two digestions with lime was *more rancid* than that used for the digestions with water alone.

How the use of more rancid fats would operate in favor of

digestions 4 and 5 may be understood from the following testimony:—

Rec., page 896, ×Q. 87, F. Verdin.

"Do not rancid fats generally saponify quicker than fresh "ones?

"A. They do. This shows there is some decomposed fat "in the rancid fats; for instance, if we take decomposed "fat and boil it, and add lime to it, it becomes a lime "soap almost instantly."

"A. × Q. 86. The only reason why I know that a fat acid "is present is in saponifying steam-rendered tallow, the "saponification of the tallow goes on a great deal quicker "than with the tallow that was rendered by the old "mode. It takes only two hours to produce a lime soap, "while with the kettle-rendered tallow it takes four hours "before the lime soap becomes solid. This shows an "indication that there must be considerable fatty acid "present. The slower saponification always produces "the best fatty acids."

No difference in results despite irregularities.

Under these circumstances, if the digestions with lime had shown ultimate results appreciably better than those without lime, it might have been, to a large degree, accounted for by these advantages in other respects which the lime digestions had over those made with water alone; but as the ultimate results, in spite of these advantages, show no appreciable difference, we would, perhaps, not even have called attention to them, but for the fact that in this tabulation of the expert, Morton, is another instance of the sustained disingenuousness, unreliability, and marked tendency to slightly falsify or leave out of consideration figures and facts which militate against the interest of his clients.

Results of imperfect intermixture.

The point which at this time we wish to call particular attention to, is simply the *vital importance* of this matter of admixture, and to illustrate to the court that, as any lessening of the heat necessitates an increase in the time of treatment,

so any impairment of the intimate mixture also necessitates either an increase in the time of treatment or an increase in the heat at which the treatment takes place.

Use of alkali a well-known means for effecting intermixture.

Now there is, besides mechanical means of making the mixture of fat and water, a chemical device well known in the arts long before Mr. Tilghman's invention and by which the tendency of oil and water to separate is greatly weakened. This chemical mixture consists of the use of a little alkali, which has the property of holding fat and water together. This property of alkali was so well recognized that in the text books its use in promoting and maintaining the condition of intermixture, known as an emulsion, is pointed out; thus Complainant's Exhibit 19, page 1559 of Record, a pharmacy publication in 1849, embodies this use in its definition of the term emulsion.

Mohr, Redwood & Procter's Pharmacy, Philadelphia, 1849.

Page 488. "Emulsions. An emulsion is a mechanical mix-
"ture, having a milky appearance, of an oil, fat, or resin,
"with water, *the mixture being promoted and rendered more*
"*or less permanent by the presence of an alkali* or gum or
"some equivalent substance, such as albumen or casein."

It was, therefore, a matter of every day dictionary knowledge at the date of this patent, that there were two ways of bringing about an emulsionized condition, that is, you could do it by the exercise of mechanical devices alone, and you could also do it, and do it easier, by adding a little alkali,* or a little gum, or a little albumen, or other such substitutes, which aided in bringing it about and necessitated the exercise of less power.

* Mitchell, who infringed by using water only, and was therefore so far disinterested in the lime form of infringement, held exactly this view of its *modus operandi*. See Record, page 857, Q. 42. * * * "When "lime is placed in contact with water it becomes hydrated, and in that "state *holds the water in contact* with the fat until the water acidifies the "fat, when the lime combines with it. * * The influence of the lime is "exerted to *hold the water in contact* with the entire mass of fat."

Use of lime mere mechanical equivalent for mechanical mixing.

It would, therefore, occur to the mind of any one trying to bring about and maintain *an intimate mixture* of fat and water, as directed by the patent, that he could increase and supplement the action of his pump or other mixing device, by adding to the mixture a little *alkali;* and it is obvious that such an addition would be the *exact mechanical equivalent of a certain number of additional strokes per minute of the pump or other mixing apparatus;* and to pretend that the use of this familiar device is a modification of the process patented, is to assume that Mr. Tilghman's specification was addressed not to those skilled in the art, but to those who not only knew nothing of the art, but who were incapable of consulting a dictionary; yet *this is the great point* on which the defendants rest their case.

Action of lime in promoting intermixture accounts for apparent advantage from its use in some of the old tests. It was of no use at all as defendants used it.

From first to last in the record there is but the one story, the fact that they used Mr. Tilghman's process *verbatim et literatim* is of no importance; it is a mere accident, because they used with it 1 per cent. of lime (one of the best known and cheapest of alkalies), and in some way or other that 1 per cent. of lime is supposed to do all the work; how and why it did this work was the subject matter of dozens of ingenious theories drawn from the well paid imaginations of a corps of experts, and when these bubble theories one after the other were pricked and dissipated, they fell back upon the naked assertion that it did it, and that how or why was no matter; and they pointed to the depositions of the witnesses referred to by the master and to numerous other similar depositions as proof of this hard fact; and then when it was pointed out as against these depositions that Mitchell, the great head and front of all the manufacturers and infringers in this country, had never used a pound of lime with his water, and yet had made the best decomposition of any of them, the defendants' expert said he did not believe it; he

did not believe the decomposition was as good, and he would not believe it in spite of the fact that the goods of this manufacturer sold for higher prices than of those of any of his competitors, who did use a little lime. Record, page 1286. Now this was bold, and a striking example of the extent to which these experts could be relied upon for devoted loyalty to their clients;—but, it was open to the objection that no reasonable man would believe it; therefore, defendants' counsel undertook to prove it, and he went off *and proved that the presence of lime in the defendants' digesters had not made one particle of difference in the character of their digestion.*

After this demonstration, this final appeal, it is absurd to go back to the experiments of Grant or Ropes or Morton or Endemann, or any of the dozen or more other witnesses, who testified to their success in obtaining imperfect decomposition with water when they disobeyed the directions of the patent. All of these depositions were put in with this single object in view,—to show that *these defendants* got great benefit out of their use of lime, and *when these defendants themselves have proved that they got no benefit out of their use of lime*, these depositions are simply disproved, contradicted and out of the case.

In each case where an imperfect decomposition is recorded, it is simply the result of *the bad judgment* or *dishonest intention* of the man who made the test;—either there was *not heat enough*, or,—there was *not a good enough mixture*, or,—*he did not give it time enough*, and, knowing the interchangeableness of these prime requisites, it follows, as a matter of course, that in another test,—in which the number of strokes of the pump were double, or,—in which a better mixture was maintained by the equally familiar device of adding a little alkali, a better result was shown; but this has nothing to do with the defendants' process, in which the heat, mixture and duration of treatment were sufficient for a perfect decomposition by the water alone, and in which the few pounds of alkali they added *had nothing to do and did nothing.*

DEFENDANTS' USE OF LIME NOT ONLY USELESS BUT INJURIOUS.

Now there is a third fact in connection with the use of lime

which must not be overlooked. The analysis of digestions Nos. 1, 2, 3 and 6 of the table defendants' Exhibit No. 15, are the analysis of the charges as they came from the digesters; this is not so of the charges Nos. 4 and 5, which are the analysis of the products of the digesters after they had been treated with sulphuric acid and washed to remove the sulphate of lime thus formed.

Where lime is used the old and new processes go on together.

Where lime is present, as it was in digestions Nos. 4 and 5, it unites immediately with the fat and forms a lime soap, a compound made up of one pound of lime and ten of fatty acids. The product of digestions Nos. 4 and 5, then, in each case, contain about ten pounds out of every hundred of lime soap; for instance, an analysis of digestion No. 4 at the end of eight and a half hours, when the first water was removed, would show, not 92.7 per cent. of fatty acids, as appears in Prof. Morton's table, but 82.7 per cent. of fatty acids *and 10 per cent. of lime soap.* To get rid of this lime soap, another operation has to be performed; that is, you have to add sulphuric acid sufficient to take up and neutralize the lime and liberate the fatty acids which it was before united with. The defendants found it necessary to use three pounds of acid to each pound of lime to do this.

One-tenth of defendants' decomposition effected by old process unnecessarily.

From this it follows that in each of the digestions, No. 4 and No. 5, the lime present did one-tenth of the work of decomposing the neutral fat at the start, and only 90 per cent. of the decomposition was left to be effected by the water; while in digestions Nos. 3 and 6 *all the work* was done by the same quantity of water, and as the results are practically equal, it follows that water alone under the conditions of the defendants' use is so thoroughly and perfectly efficient to do the work, that even the addition of this other active decomposing agent, lime, cannot bring about any better results.

Items of unnecessary expense incurred by use of lime.

But where you use lime in your digesters, you both increase

the cost of your process and diminish the purity and value of your products; you increase the cost by the following items:—

First.—The cost of the lime you use.

Second.—The cost of the acid you use to get your lime out.

Third.—The additional labor required by the treatment with acid and the washing of the sulphate of lime.

The purity of the product is diminished because, do what you will, you cannot free your crude glycerine from the soluble and insoluble salts of lime, which have formed in the digesters, and some of the fatty acids are unavoidably thrown away with the sulphate of lime.

Conclusions as to the use of lime.

We submit, then, that it is proved without going outside of the master's record, proved by the defendants and their own witnesses:—

First.—That water alone, under the conditions directed in the patent, to wit: Thorough intermixture and heated in a closed digester will entirely and perfectly decompose fats into fatty acids and glycerine.

Second.—(*a.*) That these defendants derived absolutely no practical advantage from their use of 1 per cent. of lime, and from adding their water in two charges in carrying on the process.

(*b.*) That on the contrary, their use of lime was an expensive, troublesome, and injurious mistake.

Third.—That the use of lime in connection with the Tilghman process to assist imperfect mixing, is a use to be inferred from the directions of the patent by any one familiar with the art as it was at the date of the patent, its use being as well known a device for aiding in bringing about and preserving an intimate intermixture or emulsion of fat and water, as the use of a pump or other mixing apparatus.

Fourth.—(*a.*) That while in cases where the heat, mechanical agitation, or duration of treatment *are insufficient*, the use of lime shows an apparent increase in the percentage of decomposition, such increase is accounted for, first, by the action

of the lime as an equivalent for better agitating mechanism; and, second, by the fact that the product is not all free fatty acids but a mixture of fatty acids produced by the water alone, and lime soap, due to the action of the lime alone, and in addition to the action of the water.

(*b.*) That where *sufficient* heat, agitation, and time are allowed, as in the defendants' case, the presence of lime is as inefficient as that of a pinch of snuff.

From what has already been stated the *efficiency* of the double dose of water is shown to be of the least possible practical importance. But this point of Morton's will also bear close examination even within the self-imposed restrictions which the master adopted.

Did Defendants derive Advantage from using Water in Two Doses?

Before discussing this question, it is necessary to thoroughly understand, in the first place, what relation the analysis bears to what is, *commercially speaking*, a good decomposition of fats, and, in the second place, what proportionate quantity of water the defendants used during the period of their infringement.

What is a practically good decomposition?

A good decomposition of fats, in the manufacturing sense, is determined purely by the fitness of the fatty acids for use in the manufacture of candles. This, the testimony shows, manufacturers ascertain literally by rule of thumb only, and *never* by chemical analysis. Gamble, pages 1347–8.

"× Q. 50, Is it your custom to have a chemical determi-
"nation of the amount of fatty acids in the product of
"your digester made?

"A. *It is not.*

"× Q. 51. How do you know whether it is fitted to manu-
"facture into candles or not?

"A. *We judge as it comes from the digester, by cooling a*
"*sample and noting its crystalline appearance. We judge,*
"*again, when it is cooled and ready for pressing, by press-*
"*ure of the thumb on the cake; if the oil exudes readily,*

"*and the stock which remains under the thumb is white, we* "*conclude that it is in good condition.* We judge further, "when we get it into the press, that if the oil runs out freely, "and the stock does not worm the bag, that it is in good "condition. 'Worm the bag' means the stock presses "out through the meshes of the cloth like maccaroni.

"× Q. 52. If stock does not comply with these practical "tests of fitness for candle making, you would reject it "for that purpose, would you not?

"A. We can't quite reject it.

"× Q. 53. Reject it for that purpose, my question was?

"A. It has to—when it gets in, it has to go through in some "way or other, that is the trouble. We press it very se- "verely, take out all that is inferior that we can, and use "the remainder, a portion of it, mixed with better ma- "terial. When we have it thus saponified and prepared, "it cannot very well be turned over to other uses. The "result is, of course, an inferior candle.

"× Q. 54. If the stuff won't crystallize, if you could not "press oil out of it with the thumb in the manner you "have described, but, on the contrary, the thumb should "slip over the surface of the material as it would with "raw grease, could you make a Star candle out of it "without intermixing it with a very large proportion of "good material?

"A. A Star candle could not be made from such material "without a very large admixture of good material, and "in my judgment it could not be made at all. The stuff "would have to be worked over, if it was so bad as in- "dicated in your description in the question.

"× Q. 55. *This would be true, would it not, no matter what* "*a chemical analysis might show to be the decomposition of* "*such a material?*

"A. *I think it would.*

"× Q. 56. *Has it ever been the custom of your firm to have* "*the decomposed fatty matter chemically analyzed as a* "*practical means of determining its fitness for manufactur-* "*ing candles?*

"A. *No; it has not been our custom.*

"× Q. 57. Besides the chemical analysis recently made by "Mr. Morton and Mr. Endemann, have you had other "analysis made of your decomposed fats at any time?

"A. *I do not recollect any analysis made.*"

Emery, pages 1493–4.

"× Q. 80. Did you before acidifying put it in the press?

"A. No; *we could see plain enough it would not press.*

"× Q. 81. Did you not put it in the press?

"A. We may have done so. I don't remember. *You can "tell very easily by looking at the stuff whether it would "press or not. By putting your thumb on it, in that way "(illustrating), you can tell whether it would press or not; "if it won't press it will slip out just like soap, but if it will "press, you will make a white spot on the stuff, and oil will "ooze out around your finger.*

"× Q. 82. Can you say certainly whether or not you put "any in the press?

"A. I pressed it with my thumb, I know. I know it was a "failure.

"× Q. 83. That is the only press you are sure you applied?

"A. *That is the only press I am sure of; but I know the stuff "well enough to know whether or not to put it in a press.*

"× Q. 84. How much product from the tank process, as "you use it now, do you press with your thumb?

"A. *I try some of it every day.*"

Relation between analysis and practically good decomposition.

Had the defendants' experts been actuated by a real desire to get at the truth of the matters on which they testified, they would, of course, have tested the relation which this good decomposition, as a manufacturer understood it, bore to the results of analysis. The fact that they did not determine this most essential fact, in itself demonstrates the absolute worthlessness of their testimony.

Fortunately we are not left to depend on the guesses and theories which these gentlemen are willing to hazard on this subject; and, although we are not in possession of facts show-

ing how *low* an analytical decomposition is considered good in a manufacturing sense, we are able to prove, from the testimony of the defendant, Mr. Gamble, and of the defendants' expert, Morton, that a product showing by analysis a decomposition of *less* than 95 per cent., is, in the trained judgment of Mr. Gamble, as good a product as he had ever obtained.

This is proved in the following way: Mr. Gamble testifies (page 1339, Q. 2) as to his having sent a sample of a certain charge to Dr. Morton, in April, 1883. This he accompanied with a letter (see Record, page 1533), and on page 1345, Mr. Gamble further says of this sample (Q. 34) that *he considered it* AS GOOD *as the decomposition he got by using 250 pounds pressure.*

This sample was analyzed by Prof. Morton about two months afterward. It would then, if any change had taken place in it, have shown a higher percentage of decomposition than when it was made, but the average result of three separate analyses showed it to be *94½ per cent.* * (see defendants' Exhibit No. 14, page 1531, Record).

This is of the highest importance, and *its value as evidence is greatly increased from the fact that it is totally unprejudiced and not colored by any knowledge on the part of the witnesses that it was of importance in the case.*

It may also be mentioned that in the defendants' Exhibit No. 1, it appears that a German factory was practically operating with a product which analysis showed to contain but from 86½ to 88½ per cent. of fatty acids. (See Record, page 1522.)

It should be noticed also that in Morton's answer to Q. 46, page 1377, he refers to a product showing 95 per cent. of decomposition as *a type of perfection.*

It is therefore proved, and proved entirely by the *defendants'* own evidence :—

First.—That a product showing 87 per cent. of decomposition, can be, and has been, practically used in the arts.

Second.—That a product showing 95 per cent. of decomposition,

* Morton's three analyses of this charge were as follows : 94.3, 94.4, 94.?.

is as good for manufacturing purposes as one showing a theoretically perfect decomposition.

Self contradiction by defendants as to quantity of water they used.

As to the question of the percentage of water used by the defendants, it appears in their answer to the bill of complaint (Record, page 21) that they used two doses of water, *each equal in quantity to the fat; that is, they used in all, twice as much water as fat.*

On page 1428 of the Record, Mr. Gamble states in answer to Q. 2, that he thinks each dose of water was equal to 50 per cent. of the fat, and the total water used consequently equal to and not exceeding the quantity of fat treated.

Relation of proportionate quantity of water to process.

Now as the decomposition of the fat goes on, the glycerine liberated from it is absorbed by the water, and of course the solvent power of the water is constantly diminishing in inverse proportion to the quantity of glycerine already dissolved in it.

It is self-evident that by increasing the proportionate quantity of water you will increase the rapidity of its action on the fat, other things being equal. *On the other hand, by increasing the amount of water, you of course make your glycerine water more diluted and less valuable.*

Now these defendants claim that they materially improved on the complainant's process by introducing their water in two doses; the first dose being left in the digester from eight and a half to nine hours, then blown off and another equal dose of water introduced into the digester and used for about an hour longer.

*Utility of two doses rather than one, a practical question.**

This question is not a matter of theory, it is not a question

* The plan of using the water in two or more charges has certain apparent theoretical advantages. Mr. Tilghman himself took out a patent in 1860 in which this double dosing is referred to, its supposed advantages pointed out and a claim made for it as an invention. In connection with the apparatus which he describes in the 1860 patent it is

as to whether introducing the total amount of water in several doses rather than in one dose, might or might not, under certain circumstances, be advantageous, but it is whether *these defendants* using the process as *they* used it, did or did not derive advantage by reason of introducing *their* water divided into two doses instead of applying it all in one dose.

How it might be tested.

This might have been shown by a pair of parallel experiments similar in all their conditions, except that in one the given quantity of water was all introduced into the digester at once, while in the other, it was introduced in portions. It is to be regretted that this simple test was not made, though in the defendants' Exhibit No. 15, sufficient facts are disclosed to practically decide this question.

In the digestions Nos. 3 and 4, water equal to 50 per cent. of the fat was used for eight and a half hours, then blown off and an equal quantity of fresh water added and the digestion continued for an hour longer.

In the digestion No. 6, water equal in bulk to the fat was used in the digesters for eight and a half hours, and had it been left there for an hour longer, the final analysis of this digestion as compared with the final analysis of digestions 3

---

very clear that this plan would have practical advantage. It was afterward found that the suggestion had been made prior to Mr. Tilghman's 1860 patent in a patent granted to Melsens, and no attempt was ever made to exercise any rights under the 1860 patent.

The practical value of a change of water when the process was carried on under conditions somewhat similar to that of the defendants, can be gauged by the following facts:—When Ropes' apparatus was first used in 1860, a special heater was added to introduce a second dose of water (Record, page 135, Q. 3). After three years' use of this double dose of water, Ropes worked his new and larger digester with only one dose of water (Record, page 140, × Q. 1). still using two doses in his smaller digester. Mr. Tilghman's evidence (Record, page 1174, × Q. 55) shows that Ropes subsequently worked entirely with one dose of water.

This change, after a long trial from two doses of water to one by Ropes, and the steady adherence of Mitchell to one dose, clearly indicates that under the conditions of the defendants' use there was no *practical advantage* in using their water in two doses rather than one dose.

and 4, would have shown what, if any advantage came from introducing the water in two doses rather than in one. Unfortunately for the sake of a perfect demonstration of this matter, a second dose of water was used with digestion No. 6 after the eight and a half hour period.

July tests prove that no practical advantage was gained by the double dose of water.

Practically, however, the absence of perfect parallelism is immaterial, for at the expiration of the eight and a half hour period, the product of digestion No. 6 showed by analysis *ninety-five per cent.* of pure fatty acids, that is to say, it was then chemically better than that product of which Mr. Gamble says that it was practically *as good* as he had ever obtained. Besides this the product of the first water in No. 6, is (within the limits of error in the method of analysis*) substantially the same as the product of the two doses of water in digestion Nos. 3 and 4 in spite of the fact that these digestions had the benefit of an additional hour of treatment. Certainly if digestion No. 6 had gone on for another hour with the first water, it would have equalled the final analysis of Nos. 3 and 4.

If then, Mr. Gamble's testimony as to the amount of water used is to be taken as true, it is proved that no gain whatever, whether practical or theoretical, can be attributed to their having introduced their water in two doses rather than one.

If, on the other hand, the statement of the answer is to be believed, we are without any tests on which to base a comparison, for no digestion was made in which water double in quantity to the fat was introduced in the digesters in one dose; but it does appear that a single dose equal in bulk to the fat gave in eight and one-half hours a *practically* perfect decomposition. This dose blown off and replaced by an equal dose, showed, very naturally, an increase in the perfection of the decomposition as shown by chemical analysis, but this increase did not make any difference in the practical

*Morton, page 1437: Samples giving 91.4 and another giving 92.7 should be regarded as "practically identical" and "within the limit of error in "such a method of analysis, or very nearly so."

value of the fatty acids and it was gained by a *double dilution* of the glycerine water, which, as we shall hereafter show, would enormously reduce the value of this product.

THE JULY TESTS DEMONSTRATE THAT DEFENDANTS DERIVED NO ADVANTAGE FROM THEIR USE OF LIME AND OF A DOUBLE DOSE OF WATER.

The finding of the master to the effect that the use of one per cent. of the lime and of the device of introducing the water in two separate doses, were modifications of the process patented by the complainant, and were both shown to be *efficient*, and which finding is objected to in the complainant's *eighth objection* to the master's report, is shown in the above manner to be unjustified by the evidence. For apart from all matters of theory and speculation; apart from the inferences and opinions of experts, *the absolute fact is, that the comparative tests made in July, 1883, by the defendant himself, in his own works and analyzed by his own chemist, show that neither the use of lime nor the double dose of water made any appreciable difference in the completeness of the decomposition of the fats.*

These are hard, tangible, indisputable facts proved by the defendants in their own despite; they are the final results and culmination of the long and hard contest fought out before the master in this case, in which the defendants, through their experts, undertook to prove the worthlessness, or the comparative worthlessness, of the complainant's process without these alleged modifications. These witnesses had familiarized themselves, they swear, with the testimony already in the case; had ransacked the literature on the subject, and they had made elaborate experiments. On cross-examination this elaborately prepared defense broke down, and before the cross-examination of Morton, the chief expert, was more than fairly begun, the defendants' own counsel broke in upon it and, virtually conceding the failure of his case, proposed the determination of the issue by means of a series of fair comparative tests. These are the tests of the table, Defendants' Exhibit No. 15, and, so far as they go, we submit that they should be taken as conclusive against the defendants.

Even if there were testimony in the record which conflicted with these experiments, it should have weighed as nothing with the master in comparison with them. To average the July tests with the old, exploded testimony of Werk's case and reject the Mitchell use, which confirmed their indications, was indeed to shut out truth and adopt Professor Morton's "*way*."

THE MASTER'S ERROR IN FINDING THAT THE PRODUCT OF WATER DECOMPOSITION WAS INFERIOR TO THAT OF THE OLD LIME PROCESS.—(See 7th and 9th exceptions.)

The master in his report, confuses together the two questions; first, as to whether the defendants derived any benefit from their use of lime; and, second, whether the product of the old lime saponification process was better than that obtained by water decomposition. And there is also a very puzzling confusion in his report between the percentage of decomposed fat *in the products* of a digestion and the question, as to the *quantity* of these products. This confusion, which resulted in a number of mistakes in the master's report, is especially marked on pages 1202–3.

His evident impression that a product showing by analysis say 92.5 per cent. of free fat acids was a product less in quantity by about 7.5 per cent. than one showing by analysis 100 per cent. of free fat acids, is not of course to be blamed on Morton, but his finding to the effect that the old process gave a product chemically complete in its decomposition, *was* a result of his adopting Morton's "*way* of looking at things," and is, in view of the evidence, incomprehensible.

As, however, it is an essential element of the process of reasoning by which the master gets at the great slice he takes from the chemical savings, as due to the "modifications" used by defendants, we will review it at length and show conclusively that the old process gave a product containing more undecomposed fat than that of the water process.

No evidence as to chemical perfection of decomposition by old process.

The master sets up the decomposition obtained by the old lime saponification method as the standard by which to measure the efficiency of Mr. Tilghman's process. Now there is in the record not one particle of testimony which goes to show what percentage of fatty acids was present in the product of the old lime saponification; that the manufacturers obtained by the old process a product which was, for practical purposes, well saponified, is true, but no chemical analysis of such a product is referred to in the record and therefore, there is nothing which *can be* compared with the chemical analyses which have been made in this case.

The character of the old process such that its products would naturally be less pure than those of the water process.

We have already (*ante* pages 65 to 68) explained the nature of the old process, and shown that it was recognized as a process which in practice could give only approximately decomposed products.

This is clearly explained in the Roret article which we there refer to. We have also referred to the testimony of the defendant Gamble and of the witness Emery as to the simple rule of thumb by which they recognized the commercially good product of fatty acids (*ante* pages 129–131). And, as we state above, there is no testimony in the record as to the chemical character of the old commercial product.

It is inherently most probable that an analysis of the lime saponification product would show percentages of fatty acids considerably less than that which the defendants got during their infringement, for the water process is unceasing and thorough in its search after undecomposed fats; there is no hardening of the product, and each particle of fat is sure to meet, in time, the decomposing agent.

Two experiments made by defendants show decomposition by old process to be very imperfect.

So much for the probabilities of this matter, and that the fact did not differ widely from these probabilities is indicated

by the fact that these defendants, at the very beginning of this accounting, made a quantity of lime soap. (See Mr. Gamble's testimony, Record, page 1213, Q. 50 and 51.)

That the results of this experiment were not satisfactory to the defendants is sufficiently shown by the fact that no testimony was ever introduced by them respecting them. Mr. Morton also tried his hand at repeating this process on a small scale, using 14 per cent. of lime, and after six hours of treatment his product, by analysis, contained but *70 per cent.* of free fat acids. (See Morton, Record, page 1456, × Q. 290.)

And this is absolutely the only analysis of any product made by the old process to be found anywhere in the record.

Morton's "way of looking at it."

That in view of these facts the master should have found that the product of the lime process reached a standard of chemical perfection indicates how hard it was for him to find a reasonable explanation for the great slice of the chemical savings which he deducts as due to the "modifications."

There is, however, testimony to the same effect as the master's finding and this testimony. We now ask the court to examine this testimony.

Before the July tests.

We have already referred to Morton's estimate of the old process product as one having about *95 per cent.* of free fat acid (see his testimony, page 1377, Q. 46). All his estimates, &c., up to July are founded on this assumption. We do not refer to this testimony as of any value, but simply as indicating that Morton did in fact know enough about the old process to understand that a chemically perfect decomposition could not be expected from it, and we would further suggest that from Professor Morton's unvarying practice of overestimating all figures in favor of his clients and underestimating all others to the disadvantage of his clients' opponents, it is to be presumed that when he estimated the old product at 95 per cent. he believed it to be less.

After the July tests.

On resuming the stand after the July tests, Professor Mor-

ton fully appreciated the fact that even with all the restrictions, evasions, and misstatements with which he could possibly envelope the results of these experiments, the fact was very apparent that looked at even in *his way* the results of the water process were substantially the same as his old estimate of the results of the water process. Therefore manifestly it was his duty to change his *way of looking at* the old process, also. Accordingly in his answer to Q. 191 he refers to the product of the water process (looked at in his *way*) as "*notably* "inferior in purity" and "*manifestly* less valuable" *than* the old process product, and winds up by stating that he "does not "consider such a product as coming up to the *requisite standard* "of purity in a material to be employed for the manufacture of "candles at the date of the patent."

Now, clearly, Morton intended by this answer to insinuate that the old process gave a product of practically chemically pure fat acids. He would perhaps have preferred not to state this as a fact, but we made him do it, and he did not shrink.

First, we drew out of him the fact that in this instance he had actually tried to acquire some knowledge on the subject before testifying about it (page 1456).

"× Q. 290. *What knowledge have you as to the perfection of "the decomposition obtained by the old lime saponification "process?*

"A. *I have no knowledge of my own, as I have never carried "on that process under such conditions as would enable me "to feel sure that I had secured a result equal to that which "was obtained in the commercial working of the process.*

"× Q. 291. *What results did you obtain?*

"A. In the only experiment in which I examined the re- "sults, which was one made with *14 per cent. of lime* on a "small scale in my own laboratory, *I obtained only 70 per "cent. of free fat acids*, but I had there no method of se- "curing agitation or mixture beyond that of allowing "steam from a small boiler to bubble through the mix- "ture from the end of a glass tube and an occasional "stirring by hand. My recollection is that the operation "was carried on for six hours."

This experiment, at any rate, taught Professor Morton enough about the old process to prevent his making any further examination into its workings, and to convince him that facts were not the things he wanted to help make out his point. But continuing our quotation (page 1457)—

"× Q. 294. You have stated during your examination that "'a product containing 92 per cent. of free fat acid was "'notably inferior in purity, and therefore manifestly less "'valuable, than that obtained by older processes.' Did "you mean to include lime saponification in older pro- "cesses you speak of?

"A. I did.

"× Q. 295. And yet the only examination you had made "of lime soap showed that by this method but 70 per "cent. of fatty acid was obtained in the product?

"A. In the first place, I do not consider that your ques- "tion correctly states the facts. I have never asserted "that I have made any test whatever upon the product "of the old lime saponification process, because THAT PRO- "CESS *is only used, as I understand it, when it is carried out "thoroughly and under favorable conditions.* I do not re- "gard my imperfect experiment in my laboratory and the "product there obtained as in any way representing the "product of the old lime saponification process; there- "fore, this imperfect experiment has nothing to do, and "should have nothing to do, with my conclusion as to "the relative purity of the product obtained with the old "lime saponification process. My opinion as to that is "founded upon what I have read in the testimony in this "case and in the Supreme Court record and elsewhere, "from which *I have reached the conclusion that, as far as "purity of product went, the old lime saponification process "left nothing to be desired;* that the other processes which "have been introduced in no case claimed to effect or "effected the production of a purer product, but only "claimed to secure greater economy in the production of "a product which, while possibly less pure, even, might be "pure enough for practical use under certain conditions."

In this answer we have Morton's evidence in a nut-shell. He rejects the evidence of his only experiment because its result did not correspond with his "conclusions." He begins by "*concluding*" that the old process "*left nothing to be de-*"*sired*," and from this mode of reasoning it of course followed that as he *desired* that the old process product should yield chemically pure fatty acids, it *did* yield chemically pure fatty acids.

"× Q. 296. You made a positive statement that a product "containing 92 per cent. of free fat acid was notably in-"ferior in purity to that obtained by the lime process. "*State any authority which warrants you in asserting that* "*a product of greater purity than 92 per cent. was pro-*"*duced by the old lime-saponification process.*

"A. I cannot now recall the statements from which I have "formed this opinion, but have *no doubt* that they exist in "the record in this case and in the Supreme Court record, "and therefore *can be found when they are needed.*

"× Q. 297. I think you need them now to sustain what "you have asserted to be a matter of fact. If you have "recollection enough of them to warrant you in stating "this fact under oath, as you have done, it seems to me "that your recollection should at least go to the general "substance of the statement, even if you cannot find it "in the record. State, therefore, what your recollection "is as to the testimony on which you found your state-"ment, and also how much above 92 per cent. this notice-"ably pure product was.

"A. *My recollection is that the statement or statements to which* "*I refer were to the effect that the product of the lime-sapo-*"*nification process showed a full equivalent of free fat acid,* "*which would be, approximately, 8 per cent. above 92 per* "*cent.*"

At this point we merely called his attention to the fact that even if such testimony existed in the old record, he had already discredited it by his condemnation of the modes of analysis used by all the chemists up to the accounting (× Qs. 298 to 300), and then prodded him again for his authorities, which by

the way have in fact no existence, as there is no testimony or proof of any kind in the old record as to the *analytical* percentage of decomposition in the old process product. Professor Morton, however, does produce three books which he asserts confirm his statement (see his testimony, pages 1458 to 1462), and refers to the descriptions in them of the mode of making "*commercial*" *stearic acid.* None of the passages contain any statement of an analysis of the product of the old process, but simply refer to it as one mode by which stearic acid is "commercially" obtained. But, says Professor Morton, they speak of the product as "stearic acid," and therefore they "*manifestly imply* that the products are pure." A convenient *implication* considering that what we were trying to get at was the very question as to the chemical purity of the commercial product of which the writers were speaking.

But the very extracts from which Morton quoted stated specifically that the products were *impure*, a fact which Morton evaded by frankly acknowledging that these "*manifestly pure*" products might have contained any other impurity except undecomposed fat. (See × Q. 305, page 1460.)

Far from sustaining his assumption as to the purity of the old process product, the very books produced by Morton indicate clearly that it was a mixed product of fat and fatty acid, and yet they are all that Morton could lean upon except his own *conclusion.* After reading Morton's evidence on this point, your Honors will be amused at the finding of the master.

Now, as to the real evidence on this point, we refer the court to the Roret article, printed *ante*, page 66–7, and to the *Gwynne & Wilson* Patent, which proves that the old lime saponification yielded acids so impure that when distilled off in a current of steam they left in the still such a residue of neutral fat which had escaped decomposition that it was worth while to draw it off and saponify it again with lime, and then finish the distillation of the acids so obtained. As this same Wilson used from 14 to 18 pounds of lime in saponification (page 125), the process should have been as perfect as it could be made.

"COMPLAINANT'S EXBIBIT 9944, pages 116 and 117. Gwynne "& Wilson's improvements in the manufacture of can- "dles, &c., Nov. 16th, A. D. 1843. No. 9944.

"Thirdly, our invention consists in *distilling*, in an atmos- "phere of steam, tallow, lard, whale oil, and other ani- "mal fatty and oily substances, and palm oil, linseed oil, "and other vegetable fatty and oily substances (excepting "cocoanut oil), *after they have been saponified with lime*, "alkali, alkaline earth, or metallic oxide.

"The *residuum obtained in the above-mentioned process*, and "other processes of distilling fatty and oily substances "(whether previously acidified or not), is usually of a "dark color, and, as far as our experience has gone, *we "have not found it in this state adapted for being profitably "distilled. This defect appears to arise, in the process above "described, from a portion of the fat having escaped the pro- "cess of saponification*, and we have found that if a *residu- "um* obtained in the distillation of such fatty or oily sub- "stances is *saponified and decomposed* in the usual way, "*and then* submitted to distillation with steam, valuable "products can be obtained. * * *

"Thirdly. We claim the distilling in an atmosphere of "steam, *tallow, lard*, whale oil, and other animal fatty and "oily substances, and palm oil, linseed oil, and other veg- "etable fatty and oily substances (excepting cocoanut "oil), *after they have been saponified with lime*, alkali, alka- "line earth, or metallic oxide, as above described. * *

"And, eighthly. We claim the *saponifying the residuum of "fatty or oily substances left in a vessel* after a portion has "been distilled over, *and then distilling* the same, with "the presence of the atmosphere excluded, by steam or "other suitable means, as above described."

CONCLUDING REMARKS AS TO THE CHEMICAL SAVINGS. THE LIME AND ACID, AND THE ERRORS OF THE MASTER CONCERNING THEM.

We have now followed up to a basis of fact, not only the

theory on which the defendants originally sought to dispute the fact that the chemical savings were due to their use of the patented process, but also the side issues which their arch expert Morton sought to raise after the falsehood of the original defense was proved.

We have laid before the court the facts which show, we think, that the master underestimated the savings which their use of the infringing *necessarily* brought to the defendants. That he found *less than their actual saving* is of course indisputable. We have proved that the patented process (unmodified) was capable of producing the most perfect fatty acids and effecting the whole chemical saving, and, therefore, that the "modifications," if useful at all, could only produce saving *in items not included in our claims.* We have proved that under the conditions of the defendants' use the products would have been exactly the same without any lime as they actually got with lime, and that the "modification" of using the water in two doses only effected an improvement* in the theoretical perfection of the product, not in its commercial value.

We have proved that any apparent advantage from the use of lime in any case was a consequence merely of a neglect of the patentee's clear directions, and would disappear with a slight increase of heat or a slight increase in pumping, and we have proved that so far from being a chemically perfect fat acid, the product of the old lime process contained a considerable quantity of unaltered fat.

We submit that our *first, fifth, sixth, seventh, eighth, ninth,* and *tenth* exceptions must be allowed.

Before leaving the subject of the chemical savings it will be well to call attention to the explanation of the curious fact that these defendants and many others have for so many years used a little lime with their digesters, undoubtedly believing that it was of advantage to them.

---

*As we have pointed out before, there is *no improvement* shown in fact, even chemically speaking, but here we adopt Morton's *way* of looking at it.

What the July tests, Mitchell's use, and Cloetz' test prove. Use of lime foolish.

The true bearing of the July tests, of the Cloetz test, and of Mitchell's long-continued and successful use, upon the issues of this accounting (apart from the fact that they are a demonstration of the efficiency of the water process, unaccompanied by the use of lime), is this,—they proved conclusively that without using any greater, in fact, even with much less heat and pressure, water alone in the defendants' digesters will cause a perfect decomposition of the fats, and that if any imperfection in the decomposition had been noted, they proved conclusively that it must have been due to *an insufficient mixing of the water and fat*, a matter easily remedied by increasing the number of pump strokes or by using a larger or better pump. They proved, in short, that Mr. Tilghman's directions as to the essential nature of a perfect intermixture cannot be neglected with impunity; and they proved conclusively that the use of lime in such digesters is a clumsy and foolish device. Since no reasonable person can dispute that if water alone will do the work, in a given time and at a given temperature, that it is expensive, troublesome, and unprofitable to use lime in your digesters rather than to work your pump a little harder. See Mr. Tilghman's testimony, Record, pages 1156–7.

Origin and vitality of mistaken idea as to utility of lime.

To turn from this direct and positive testimony to the old, imperfect trials of Ropes, Grant, &c., as the master does, indicates an absolute want of comprehension of the issue involved, and his references to these old depositions after the clear demonstration of fact in the July experiments, is most surprising and inexplicable; in fact, the whole history of this lime fetich, is a most curious instance of the wonderful vitality of a lie and of the unlimited capacity for being gulled which afflicts human nature. It began immediately after the issue of Mr. Tilghman's patent, which had no sooner been made public than that numerous class of geniuses whose especial function

it is to hook themselves on to every real invention by means of little changes and additions which they dignify with the name of inventions, got to work at it, and among the first of these was a Frenchman named De Milly, who took out a patent in 1855 for the process of decomposing fats by means of water at high temperature and pressure *and a little lime*. This man went all over Europe, showed the manufacturers that he got a good decomposition, showed them what a great saving was made by this process where only 1 or 2 per cent. of lime was used, over the old process where about 14 per cent. of lime was used, and induced them to buy rights under *his patent* and to use *his process*.

Now, of course, it was necessary for De Milly to tell the manufacturers that it was the presence of lime which brought about the results, and, as the manufacturers very naturally believed him, it got to be a generally accepted axiom that *you must* have lime in your digesters, and to this day, no doubt, many manufacturers are going on with their business, using, some more and some less, lime, and firmly convinced that, in some way or other, this lime is doing their work for them.

Other pretended modifications of complainant's invention.

There were, besides this, a number of other frauds of the same character; thus, Wright and Fouché took an old apparatus well known in the arts at the date of Mr. Tilghman's patent, and took out a patent for carrying on his process in this old apparatus; this was dignified with the name of Wright and Fouché's *process*. Another man, named Melsens, devised an apparatus of wonderful complexity of appearance in which to carry on Mr. Tilghman's process, and this received the imposing title of Melsen's *process*. But the plan most favored of this class of inventors was that of De Milly, and a perfect army of them took out patents for *the process* of decomposing fats by water under high temperature and pressure *and the addition of a little something else;* these, of course, were announced to the world as the Tom, Dick, or Harry process, as the case might be. For the most part, they had

this advantage over De Milly's process, that while it cost a good deal to get the lime out, a little iron filing or zinc filing,* or tin filing simply sank to the bottom and got rid of itself. (See for an account of this swarm of locusts, Mr. Tilghman's testimony, Record, page 1162, Q. 20.)

Mr. Tilghman, referring to the numerous patents taken out for trifling variations of his process, says :—

> "I once counted over twenty such patents taken out in
> "Europe for such little variations of process or appa-
> "ratus; some claimed a little acid with the highly heated
> "water, some a little alkali with it, some a little alcohol,
> "and so on, till one poor man, Mons. Jaques Martin, of
> "Paris, was reduced to claiming a little perfume—essence
> "of lavender—mixed with the hot water."

Now any one of these quacks could go to a manufacturer who was using Mr. Tilghman's process with an insufficient mixing apparatus, or at too low a temperature, and demonstrate to him that by using his particular cure-all (and incidentally running his pump a little faster) a better product could be obtained, consequently great honor and glory for the quack and scorn for Mr. Tilghman.

Why, the defendants actually put Baujard and Janssen on the stand to prove how unsuccessful Tilghman's process had been in France, and it came out that what they called the water process was one in which there was *no mixture* of the fat and water (see Baujard, page 1476, × Q. 39). Naturally, it was inferior to one where lime (*and* a pump) were used.

In Mr. Tilghman's patent there is a full explanation of all the conditions of the operation, and yet to this day many manufacturers go on with the use of lime or some other nostrum, and won't believe that nothing more is wanted than *thoroughness* in the mixing, and higher heat for quick operations.

---

* Defendants' witnesses, Janssen and Baujard, are now engaged in introducing the *Baujard process*, which consists of Tilghman's process, *and* the addition of $\frac{3}{1000}$ to $\frac{3}{1000}$ per cent. of zinc filings.

DEFENDANTS' GAIN IN GLYCERINE, AND THE MASTER'S ERRORS (*a*) IN REFUSING TO ALLOW THE COST OF CONCENTRATING THE OLD PROCESS GLYCERINE TO THE DENSITY OBTAINED, AND (*b*) IN REPORTING THAT THE GLYCERINE OF THE OLD PROCESS WAS DOUBLE IN BULK THAT OF THE INFRINGING PROCESS. THIRD AND FOURTH EXCEPTIONS.

But little can be said as to these errors in addition to the statement of the proofs which support our claim, for which see *ante* pages 19 to 24, to which we beg the court to refer.

The Master's Error as to the quantity of the defendants' glycerine.

As we show in the statement of our case, the defendants themselves testify that they sold 65,312 barrels of glycerine, each containing 330 pounds of the solution, and that 65,312 multiplied by 330 amounts to 21,552,960 is a fact of such easy demonstration that it is inexplicable how it could have escaped the master.

That 21,552,960 is not half of 23,322,777, the number of pounds of fat treated by defendants, is also quite clear. It is just 92.4 per cent. of it, and this percentage is certainly not less than the percentage of glycerine water in the old process, as we show from the defendants' own testimony concerning it.

The master's finding that the glycerine water sold by defendants was equal to but half the quantity produced by the old process is therefore impossible and inexplicable.

The master's other assertion of fact in this connection, to wit, that the glycerine water sold by defendants was the water of the first dose only, is a mere inference of his own, impossible, if, as Mr. Gamble says is his impression, each dose used was equal to 50 per cent. of the fat, but quite natural if, as the answer states, each dose was equal in bulk to the fat.

Correction of Master's error as to quantity of defendants' glycerine.

This error of the master is embodied in his report, see "Table B," on page 1206 of record, in which he estimates the quantity of glycerine water from the old process as double the amount produced by the infringing process instead of being equal in amount, as we have shown that it would have been.

The correction of this error in the table B, which is made by simply dividing the quantities and values of the glycerine water from the old process by two, and subtracting the corrected valuations from the values actually received by the defendants, from their glycerine water, shows on the master's basis a gain of $82,442.31, for which the defendants must account, instead of $61,701.77 as found by the master.

The Master's Error as to the cost of concentrating.

The facts on which we base our claim that in the defendants' gain in the item of glycerine, the cost of concentrating the equal bulk of old process glycerine to the same density as the glycerine obtained by the infringement should be included are fully set out *ante*, pages 19 to 24. The master acknowledges the justice of the claim, but finds the facts insufficient to show its pecuniary value. We submit the facts for the consideration of the court, feeling that they quite make out our claim.

If our proofs are not sufficient one thing is sure, and that is, that it is not because of any reason or facts referred to by the master in this connection.

What we show is—That to bring their 3¼° glycerine-solution to a density of 15° the defendants had to evaporate 5½ barrels of water out of every 6½ barrels of the 3¼° solution. That the *cost* of doing this was $1.55 for each barrel of 15°, or just $0.2818 for each barrel of water evaporated. We thus show that to concentrate the old glycerine water of ¾° density to 3¼° would require more* than 4½ barrels of the old solution for each one of 3¼°; but we adopt this figure from which it follows that out of each 4½ barrels of the old solution it would be necessary to evaporate 3½ barrels of water to bring it to the standard density of the infringement. From this it follows that if they had been using the old process the defendants would have had to evaporate 50,240 barrels of water to bring their glycerine solution to the density actually obtained by them.

Now we say that as the actual cost to the defendants for

* On the master's own calculation it would be 5⅓ barrels.

evaporating a barrel of water is $0.2818, this would have cost them $14,157.64.

The master, however, says that it does not follow that because it cost $1.55 to evaporate 5½ barrels of water, that it would cost $0.98 to evaporate 3½ barrels, and reasons that if it was necessary to get rid of the 5½ barrels, getting rid of 19¼ more* would affect the cost but little. This reasoning, however, though it sounds plausible, will not bear examination. Look at the sort of oparation this concentrating is.

There is a big open vat with a coil of steam pipe at its bottom. The vat is filled with the glycerine solution, steam turned into the coil, and the water gradually evaporated. Now, the average cost of this operation the defendants swear is $0.2818 for each barrel of water gotten rid of. This has no connection with, or relation to the density of the solution. It would be just the same if there was no glycerine in the water in the tank, and the master's reasoning would bring us to the inevitable conclusion that it costs no more to evaporate two or three barrels, than it does to evaporate one; a result which demonstrates the fallacy of the reasoning. But the support which the master adduces to sustain his reasoning is most remarkable; he says, "The only witness whose testimony is "directly in point says, it (the cost of concentrating glycerine), "would not be material." This witness is Grant, see page 1060, Qs. 88 and 89. On the same page, × Q. 83, he states that he is the mercantile, not the manufacturing partner of his firm, and that he sold all his crude glycerine to Bower, × Q. 86.

He states, R. D. Q. 88, that as he thinks the only difference between the old process glycerine and the new would be in their degree of concentration, and then says, that the cost of concentrating would not be much, R. D. Q. 89.

This is the master's *direct evidence*, a witness who don't pretend to know anything about the matter, but amiably guesses at it when asked by defendants. If the evidence of the defendants themselves to the effect that concentration

*This follows, as it requires 4½ barrels of ¾° solution to make one of 3¾° and 6½ barrels of this density to make one of 15°.

cost *them* $0.2818 per barrel of water be *indirect*, it is at any rate better than a mere guess.

But the master has more *support* for his views.

The defendants testified that they sold their crude glycerine of 3¼° and then concentrated it to 15°, charging the exact cost of concentrating to the purchaser, viz, $1.55 per barrel of 15°. To this statement the master refers in connection with the cost of concentrating from ¾° to 3¼°, saying, "*Besides, "if paid by the purchaser it would not affect the profits of the "respondents"*." (See page 1199.) Does he mean that purchasers would pay as much for glycerine solution of ¾° as they paid for 3¼°, as much for 3½ barrels of water and one of 3¼° glycerine as for 4½ barrels of 3¼° glycerine? He must, for, absurd as this meaning is, it is the only meaning that can be attached to this reference.

An examination of the master's reasons does not lend any strength to his conclusions.

THE MASTER'S ERROR IN REPORTING THAT THERE WAS NO MATERIAL ECONOMY IN THE OPERATION OF THE INFRINGING PROCESS OVER THE OPERATING COST OF THE OLD PROCESS.—SECOND EXCEPTION.

The master finds (see his report, pages 1198–9) that (aside, of course, from the savings of lime and acid and the gain in glycerine) there was no material difference in the cost of carrying on the infringing process and the cost of carrying on decomposition by the old process. This finding is the subject-matter of the complainant's *second exception* to his report.

We requested the master to find that the defendants, by using the infringing process rather than the old process, had, in the first place, saved a quantity of fatty acids, which, under the old process, were inextricably entangled in the sulphate of lime and thrown away with it.

In the second place, that they saved in the item of labor, and, in the third place, that they saved in the item of fuel.

The evidence on which we rely to make out these items of savings is concisely cited *ante* pages 24 to 28.

We contend, and submit to the court, that it warrants and requires the conclusion that the defendants saved a large sum of money in these respects.

CORRECTIONS IN THE FIGURES OF THE ACCOUNT NECESSITATED BY CORRECTION OF THE MASTER'S ERRORS.—ELEVENTH EXCEPTION.

The subject-matter of the complainant's eleventh exception is the master's computation of the total gains and savings accruing to the defendants.

The correction of this error is, of course, involved in the correction of the different findings as to fact and amounts which have been already discussed.

The master finds the defendants' gains and savings to be $129,441.47.

The correction of his error in addition (see page 1198), increases this by $1000 to $130,441.47.

The correction of his other arithmetical error as to the glycerine pointed out in our *fourth exception* ($20,720.63) raises the total to $151,162.10.

The correction of his error in reporting a saving of 12 pounds instead of 13 pounds of lime by the use of the infringing process (see our *first exception* $15,353.27)* raises the total to $166,515.37.

The further correction of his error in reporting a saving of 2½ pounds of acid for each pound of lime saved instead of 3 pounds (see our *first exception*, $41,399.92)† the total $207,915.29.

The further correction of his error in deducting $114,991.76 from the actual gains and savings as due to the use of lime, and a double dose of water—the "modifications" (*Fifth, Sixth, Seventh, Eighth, Ninth, and Eleventh Exceptions*) raises the total to $322,907.05. The correction of his error in refusing

---

* See note, page 70.

† The acid saving is underestimated by $55,920.98 in all, but $14,521.06 of this is included in the correction just above.

to allow the cost of concentrating the old process glycerine to the strength obtained by the infringement ($14,570.75) raises the total to $337,477.80.*

And there was, besides, the saving in fat, fuel, and labor which the defendants gained by their infringement.

Interest.—Twelfth Exception.

Our last exception is to the finding of the master to the effect that the circumstances of this case do not warrant the award of interest on the gains and savings.

In all the cases where this court has referred to the subject of interest on profits it has implied that such an award was within the power of the court, and would be exercised in a case the circumstances of which warranted it.

If the court had in mind a case where the infringement was utterly without excuse or extenuation, where the robbery of a patentee was deliberate, calculating, and cold-blooded, this is such a case.

We take pleasure in saying here that one of the defendants, Mr. J. N. Gamble, who was frequently on the stand during the accounting, showed himself to be a man of unflinching honesty and truthfulness, and we have no reason to doubt that the firm as a whole are in the ordinary affairs of life good and honest men.

Their treatment of Mr. Tilghman is but an instance of the too common moral blindness which leads men who would shrink from cheating in business or from the theft of tangible property to rob an inventor of his intellectual property without thought of moral turpitude. The theft of an invention they seem to think the mere beginning of an intellectual duel in which they can be championed by scientific gentlemen with *conclusions* for sale to the highest bidder. Conviction of the

* The difference between this total and that named in our eleventh exception, viz., 333,968.93, is due to our more liberal estimate of the glycerine actually present in the old process solution. The master is correct in his finding on this point, but as we state *ante*, pages 21, 23, and 24, in dealing with the glycerine, we have in this and many other particulars conceded more than defendants could justly claim.

robbery is to them no more than an umpire's adverse ruling in a game of base ball.

It is time that the courts which have the charge of patentees' interests should make it clear to these gentlemen that inventions, when patented, are property, and their theft, robbery.

Behind these defendants is *Michael Werk*, the instigator of the wrong, the man under contract with them to hold them harmless, and stand between them and the consequence of the injury to Mr. Tilghman which they conspired with him to commit. In claiming interest on the savings and gains proved in this case, we simply seek to lay on *Mr. Werk* the full consequence of his contract.

Argument for Complainant as Appellee.

The refusal of the lower court to review or go into the master's findings as to the facts proved before him, has of course put upon complainant the burden of assailing the report as filed.

As to those exceptions of the defendants which relate to the modifications so called;—the use of a little lime, and of introducing the water in two doses, we have said all that can be said.

So also as to their exceptions which raise the point that damages and not profits are the proper measure of the defendants' accountability.

The remaining exceptions, so far as they relate to matters of fact raised by the evidence, are founded on the twin propositions:—

First, That the efficiency of the complainant's process is to be measured by the practical efficiency of the coil apparatus described in his patent; and,

Second, That the coil apparatus is not a practically efficient machine in which to carry on the process.

The Coil Apparatus.

The defendants in this case incurred great expense, and put themselves to much inconvenience and trouble by building and experimenting with a large apparatus, intended, they say, to be a reproduction of the one described and shown in the patent. The structure and operation of this machine is the subject-matter of much of the testimony introduced in their behalf, but before discussing this apparatus and the testimony

concerning it, it is well to consider what bearing it *could have* upon the issues properly raised in the account.

Questions as to coil formerly before this Court.

This coil apparatus, its merits and demerits, and its bearing on the case, is dwelt upon at great length in the testimony in the main case, and it was most exhaustively argued here in behalf of the defendants,

First.—That the patent should be limited to the treatment of fats in this or a practically identical apparatus; and

Second.—That this apparatus was not a practically useful one, and hence, that the patent was defective in not pointing out any practicable method by which the process claimed could be carried into effect.

Bearing of coil on construction of patent.

The questions of law and fact involved in the first of these contentions, forms the subject-matter of most of the opinion of this court in the former appeal. The conclusion of the court and its application to the present issue is very clearly expressed in the following extract from the opinion:—

"It only remains that we should express our views on the "question of infringement. The defendants advance "several reasons for the purpose of showing that their "process does not conflict with that of Tilghman. *First,* "because they do not use the apparatus described in the "complainant's patent; but use a boiler in which the "charge of fat and other materials is placed and heated; "and do not mix the fat and water in the manner pointed "out in the specification of the patent, but, on the con- "trary, have inserted in the boiler a pump which forces "the water as it settles to the bottom upwards to the top "of the mass and pours it upon the upper surface, whence "it again finds its way down through the fat, thus keep- "ing up a constant mixture. *It is unnecessary to add* "*anything further on the subject of the form of the appa-* "*ratus used. The patentee is not confined to a metallic coil* "*of pipe heated in a furnace; but his patent extends to and* "*embraces any convenient vessel for holding the mixture,*

"*which is strong enough to sustain the pressure necessary to* "*prevent the water from being converted into steam.* The "defendants use such a vessel, and use it for the purpose "indicated and pointed out in the patent. The vessel "which they use has the requisite strength to prevent "the water from being converted into steam, and does "effect that object. *And as to the defendants using a dif-* "*ferent method from that suggested in the patent for keep-* "*ing up the mixture of fat and water, that is of no conse-* "*quence. The keeping up of the mixture is the important* "*thing. That is a necessary part of the process.* They "employ such a device for effecting this as is adapted to "the form of vessel in which they heat the material. "Using a boiler instead of a coil of pipe, for this pur- "pose, they are obliged to employ an additional, or "modified means for keeping up the mixture. They "only employ such means as, in view of the change "adopted in the form of the heating apparatus, and of "the known appliances in use in analogous processes, "would naturally suggest themselves to a mechanic "skilled in the art. Or, if the mode of effecting the con- "tinued mixture adopted by the defendants should be "deemed a new and useful improvement, they might per- "haps have a patent for that peculiar device without "being entitled to use Tilghman's process, on which it is "but an improvement."

Practicability of coil apparatus.

As to the second point urged in behalf of the defendants, the court very summarily disposes of it, by finding, as a matter of fact, that the coil apparatus described in the patent was practically useful.

"It was objected that the particular apparatus described in "the patent for carrying the process into effect cannot be "operated to produce any useful result. We have examined "the evidence on this point, and are satisfied that it shows "the objection to be unfounded. A recapitulation of "this evidence is not necessary. The testimony of Tilgh-

"man himself, of Professor Booth and of Mr. Wilson "is directly to the point."

The decree.

Following this opinion of this court, the decree as settled by his Honor Judge Baxter is

(*a*). That the patent is for a process.

(*b*). That the defendants used this patented process.

(*c*). That the defendants shall account for the gains, profits, savings, and advantages which they have received or which have arisen or accrued to them by the use of *the process* patented.

Possible relevancy of the coil in the account.

Now, unless the above issues formerly urged before this court, and decided by it, are to be considered as still open for further proofs and argument, there is but one legitimate opening for further testimony about the coil in this stage of the case, and that is, to show the character of the decomposition effected at the high temperature mentioned by the patentee as compared with the defendants' products. And it is unquestionable that this was the main object had in view by the defendants' counsel and their experts, when they advised the preparation of this elaborate and costly mechanism.

We have already reviewed the evidence of Professor Morton showing how he brought the coil experiments to the assistance of his 90 to 150 pound pressure tests (tabulated in Defendants' Exhibit No. 14, page 1531), and we have shown that he appealed to the coil tests as confirming the indication of the low pressure tests, to the effect that water could not effect a decomposition of more than 80 per cent. without lime.

The July tests pricked this bubble, and clearly indicated that the results of the coil tests were no true indication of the efficiency of the water process in this or any other apparatus. We will presently show how unfair the coil tests were.

Coil testimony absolutely irrelevant to account.

Now in the face of this break-down; in the face of the proof prepared and introduced by themselves, that the use of lime, so far from assisting the water, had merely added to their ex-

pense, of what possible relevancy could the coil be to the issues of the accounting? There is no question in this case as to what the defendants might have saved under any hypothetical way of using the process; the question is simply what they did save. There is nothing in the decree as to the efficiency of one apparatus over another, and properly so; for it is no business of the complainant whether the defendants saved or lost money by reason of their use of one apparatus rather than another; the saving in lime acid and glycerine are due simply to the use of the Tilghman process, and they have no connection whatever with the kind of apparatus used for carrying on the process. It is indisputable that the expense in fuel, &c., is less by the infringing process than by the old process; but as these items depend to some extent upon the apparatus used, we waive all claim for an accounting in these matters. Whatever advantage the defendants have obtained in these items will remain to them; we ask for nothing but the chemical advantages arising from the complainant's chemical discovery.

Defendants' contention as to coil apparatus.

Defendants' counsel not only entirely failed in his effort to show that the Tilghman process was inefficient without the aid of a little something else, but in his efforts to do so, demonstrated, beyond the possibility of doubt, that all of the chemical savings made by the defendants were due to the use of water alone, and would have been still larger had they not been so ill advised as to use lime in connection with it. He was therefore driven back to his old position in the main case, and almost the whole of his argument before the master was based on the exploded construction of the patent as being for a machine, and on the experiments with this machine made by the defendants, the unfairness of which is glaringly apparent.

The efficiency of the coil aparatus, counsel says, is the measure of the efficiency of the process as patented.

We reply:

(1.) That this as a matter of general law is not so.

(2.) That the point has been disposed of, and the law of *this case* is otherwise.

What the patent says as to coil.

At the beginning of his specification (Record, page 9) the patentee states what his invention is, and says, as to the apparatus, that it may be "*any convenient vessel*," the prime requisite of which is that it "MUST be closed." He commenced the description of the coil as follows:—

"The process *may* be performed more rapidly and also con-
"tinuously by causing, &c."

And before describing it, he expressly disclaims the intention of making it a part of the invention as follows:—

"* * * *Which apparatus I do not intend to claim as any*
"*part of my invention.*"

The patentee in effect says, I will tell you about one of the "*vessels*" I have used, and which I think is a good one, but you must understand that this machine is not a part of my invention. Now, if he had said nothing about this machine what difference would it have made? If you erase all this description from the patent you will find it perfectly clear and not a whit changed in meaning or scope. Thus we will print the patent omitting such parts as the inventor says are not a part of his invention.

TILGHMAN'S PATENT, OMITTING DESCRIPTION OF DISCLAIMED APPARATUS.

To all whom it may concern.

"Be it known that I, Richard Albert Tilghman, of Phila-
"delphia, have invented a new and improved mode of
"treating fatty and oily bodies, and I hereby declare that
"the following is a full and exact description thereof.

"My invention consists of a process for producing free fat
"acids and solution of glycerine from those fatty and
"oily bodies of animal and vegetable origin which con-
"tain glycerine as their base. For this purpose, I sub-
"ject these fatty or oily bodies to the action of water at
"a high temperature and pressure, so as to cause the

" elements of those bodies to combine with water, and " thereby obtain at the same time free fat acids and solu- " tion of glycerine. I mix the fatty body to be operated " upon with from to a third to a half of its bulk of wa- " ter, and the mixture may be placed in any convenient " vessel in which it can be heated to the melting point " of lead, *until the operation is complete.* The vessel must " be closed and of great strength, so that the requisite " amount of pressure may be applied to prevent the con- " version of the water into steam.

"The melting point of lead has been mentioned as the pro- " per heat to be used in this operation, because it has " been found to give good results, yet the heat has been " carried considerably above the melting point of lead " without any apparent injury, and the decomposing ac- " tion of the water becomes more powerful as the heat is " increased. By starting the apparatus at a low heat, and " gradually increasing it, the temperature giving products " most suitable to the intended application of the fatty " body employed can easily be determined.

" I believe that it will be found useful to fix diaphragms " pierced with numerous small holes, so that the liquids, " being forced through these obstructions with great ve- " locity, may be thoroughly mixed together.

" When it is desired to diminish the contact of the liquids " with iron, the apparatus may be lined with copper. The " hot mixture of fat acids and solution of glycerine sepa- " rates by subsidence. The fat acids may then be washed " with water, and the solution of glycerine concentrated " and purified by usual means.

" The fat acids thus produced may, like those obtained by " other methods, be used in the manufacture of candles " and soaps, and applied to various purposes, according " to their quality; and when desired, they may also be " first bleached by chemical agents, or purified by distilla- " tion, in a current of steam, or in a vacuum, as is now " well understood. I prefer that the fatty bodies should be " previously deprived, as far as practicable, of such impu-

"rities as would cause the discoloration of the fat acids "produced; but when the fat acids are to be finally puri- "fied by distillation, this preliminary purification is of "less importance.

"When sulphuric acid, nitrous fumes, or other corrosive "agent, shall have been used for purifying, hardening, or "otherwise preparing the fatty body to be operated upon, "I take care that all traces of it shall be washed out, or "neutralized, before passing it through the apparatus.

"Some fatty bodies (particularly when impure) generate, dur- "ing the process, a portion of acetic or other soluble acid, "which might tend to injure the iron; in such cases, I "add a corresponding quantity of alkaline or basic mat- "ter to the water and oil before they are pumped in.

"Having now described the nature of my said invention, "and the manner of performing the same, I hereby de- "clare that I claim, as of my invention, the manufacturing "of fat acids and glycerine from fatty bodies by the "action of water at a high temperature and pressure."

Now, what has the patent lost or gained by this omission?

Look now at the letter to the Commissioner of Patents, written before the patent issued (Record, page 470–1), and which elaborately explains that when the inventor said "*any "convenient vessel may be used*," and that the coil was *not* his invention, he meant just what he said:

"The form of apparatus in which the materials are treated "according to the invention, may be *indefinitely varied* to "suit the ideas of the constructor, the only essential "point being that it shall be capable of withstanding the "necessary heat and pressure."

No invention in defendants' apparatus.

Did it require invention to devise an apparatus for carrying this process on? Clearly not. The requisites pointed out are that the fat and water should be kept in intimate mixture and heated under pressure. The existing digesters with mixing apparatus would at once occur to a reader familiar with the art, and what these well-known machines were we have

shown in Exhibit "23" (opposite page 1561 Rec.); any of these, as your Honors can see, will carry out the process perfectly and can be constructed directly from the drawings themselves.

It may well be that there was and still is a field for invention in devising new forms of apparatus and appliances for such apparatus, but that does not affect this case. In what particular does the defendants' apparatus differ from Figures 2, 5, 7, 8, 9, 11, 12, and 13, of Exhibit "23?" Certainly in none that involves invention.

So held by this court.

In the opinion of this court, all these matters were considered and decided on the former appeal, the court holding that this apparatus involved no invention beyond what was clearly indicated by the patent to one having knowledge of the business, and this is, therefore, the law of this case.

This evidence properly excluded by the master.

It is remarkable that the defendants should have gone into this matter before a master, appointed by a decree made under the mandate of this court, and of which the opinion is in express terms made a part.

The theme of some hundred and twenty pages of Mr. Parkinson's printed argument before the master was the coil, which, by a strange confusion of ideas, he calls "the *process*, "as it came from the Tilghman patent," "the unimproved "*process*," &c., &c.

The master very properly excluded this matter from his report as clearly irrelevant, and this ruling is the basis of most of the defendants' exceptions.

But, in spite of the patent, in spite of the finding of this court, in spite of the demonstrated unfairness and worthlessness of the so-called tests made by defendants, and in spite of common sense, it will undoubtedly be again pressed for the consideration of the court.

DEFENDANTS' CONTENTION AS TO COIL NOT ONLY IRRELEVANT, BUT WITHOUT BASIS OF FACT.

Now, while we do not anticipate that this matter will again

be gone into by your Honors, we will briefly call attention to the parts of the literature of the case in which the defendants' pretensions are refuted.

Evidence in the old Record.

A great part of counsel's argument was founded on the testimony concerning the coil in the old record. All this was, of course, here before, and the complainant's reply to it will be found in our old brief, pages 78 to 108; see also pages 143 and 144. The unfairness of the defendants' testimony and experiments are there pointed out and the proofs referred to, which demonstrate that this much-abused coil is a convenient and practical vessel for carrying out the process.

How disposed of in the opinion.

In view of the construction given to the patent by the court, it was, perhaps, not necessary to go into this question, but it was reviewed and disposed of as follows:—

"It is objected that the particular apparatus described in "the patent for carrying the process into effect cannot be "operated to produce any *useful result.* WE HAVE EX- "AMINED THE EVIDENCE ON THIS POINT, *and* ARE SATISFIED "THAT IT SHOWS THE OBJECTION TO BE UNFOUNDED. A "recapitulation of the evidence is not necessary. The "testimony of MR. TILGHMAN himself, of PROFESSOR "BOOTH, and of MR. WILSON is directly to the point."

What the opinion means.

If the court should be led by the ingenious argument of the learned counsel on the other side, to entertain any doubt as to what it meant by this part of its opinion, the opinion itself will show how to resolve the doubt. *Counsel says*, the court decided merely that the apparatus was *useful* in the sense of not being *injurious.* The *court says*, we are satisfied that the testimony of Mr. Tilghman, Professor Booth, and Mr. Wilson as to the utility of the machine, is correct. Look then at what *they* say:—

TILGHMAN, page 1152.

"Q. 5. I think the high pressure apparatus is much more

"economical, both in first cost and in the expenses of "working, &c." See his explanation following, and on page 1015.

BOOTH, page 696.

"Q. 140. A. * * I regard the process as a most perfect "manufacturing process—that is, making fat acid and "glycerine in an economical manner, and adapted to "commercial uses."

WILSON, page 130.

"A beautiful, original chemical idea, *well carried out.*
"I went to *see* Mr. Tilghman's little apparatus *at work.*"

Certainly these gentlemen say that it was a practically useful apparatus. And the court might also have referred to a great deal of additional evidence to the same effect, see, for instance, Bridges', page 84, Q. 7; Rogers', page 88, Q. 6, Graham's letter, page 1162; Hale's and Meyer's letters, page 1182.

NEW TESTIMONY ON THE ACCOUNT.

Proctor & Gamble's Coil Apparatus.

The defendants at a great trouble and expense, constructed a large coil apparatus, intended, it is claimed, to be such an apparatus as that described at length in Mr. Tilghman's specification. This machine, as we have said before, seems to have been intended to aid their experts in the demonstration of their supposed discovery that water would not decompose fat at any temperature or under any conditions, and, built and operated as it was, it failed for a while to *undeceive them* and prevent their making the melancholy spectacle of themselves which they did when they appeared as witnesses.

In doing this they were merely following the example set by Mitchell, who also constructed a coil apparatus and successfully proved that if Mr. Tilghman could construct a coil like that shown in his patent that *would* produce well decomposed fat acids as is proved by Willson, Booth, Rogers, and the others, he, Mitchell, could construct a coil which he

could work unsuccessfully by willfully violating the directions given.

Now we are quite prepared to admit that *these* defendants, like the old ones, are quite capable, with the assistance of *experts* of constructing an impracticable machine and of operating it so as to get bad results. That much they proved by their early experiments in their own digesters.

But no amount of proof as to their success in constructing faulty apparatus would off-set the proofs referred to by this court as to the practicability of the *Tilghman Coil.*

But as we know that defendants' counsel *will* argue this question over again and indeed will argue but little else, we will briefly call attention to the facts which *he will not mention* in connection with these experiments.

Construction of defendants' coil.

The manner in which this coil apparatus was built is described by the mechanical expert HILL on pages 1296 to 1303.

The Joints.

In the first place Mr. Hill in constructing the coil deliberately disregarded the positive directions of the specification that "the ends of the tubes should be joined together by *welding* "*to make the requisite length,*" and he did this in spite of the fact that he had just examined another similar machine which had to be discarded by reason of defects caused by a similar disregard of the specification. Indeed it would almost seem as if he did this *because* he knew it would result disastrously.

The outer joints which alone it is not "*practicable*" to weld, and which Mr. Tilghman directs *shall be* "Perkins joints," Mr. Hill deliberately made in different ways. See Hill, page 1307.

"* * By the way, that was a Perkins joint also next to "the coil, *while the other exposed joints were flanged joints* "*with copper gaskets.* * *"

Page 1312.

"* * Now I wanted to say that we took off the flange-"joint, the one that gave us the most trouble in the centre

"of the pipe, and supplied its place with a coupling with "right and left threads *similar* to the Perkins joint, "*although I am not sure that we used the chamfered ends to* "*the pipe at all.*"

Pages 1313–14. By MR. B. C. TILGHMAN:

"Q. 7. Was the Perkins joint between the heating-coil and "the cooling coil made by means of a sharp edge on one "tube biting into the flat surface of the other tube?

"A. That joint was made while I was not present at the fac- "tory. The instruction to Mr. Manning (the piper) was "to make such a joint there, and, in fact, all other places; "but all that I can answer for that is, that it is a right and "left thread; and, if it is not a Perkins joint, *it only lacks* "*this cutting feature.* I am not certain, because this joint "was made while I was not present.

"There is a peculiarity about the joints here, that they "would remain tight for a period of time and then leak. "This particular joint was screwed up as tight as we "could make it, and for an hour there was no evidence of "leak, when, suddenly, it began to spurt."

By Mr. PARKINSON.

"Q. 8. Was what you say in your last answer about your "having no personal knowledge as to whether the Per- "kins joint there referred to was chamfered or not, in "reference to the joints within the casting, or only to "that outside?

"A. These joints immediately outside of the trunnions. "There were two of them made in this manner—the inlet "joint, which never gave us any trouble, and the outlet "joint, where the serious leakage occurred. Those were "joints outside of the decomposing coil proper."

Was a more deliberate piece of insincerity ever before heard of.

The casting which Mr. Hill put around his pipes *cracked.* Of course it did. When Mr. Hill put Perkins' joints instead of welded ones *in the coil*, he knew it would crack. But that such a casting put around a welded pipe by a competent workman would crack, is disproved by Mr. Jones. (Pages 1483–84, Q. 12.)

The kind of joints which Hill put on the lengths of pipe inside the casting is shown in the drawing facing page 1553.

Now this joint *is not* a Perkin's *joint* at all. (See Jones' testimony, page 1483, Q. 11.) The real Perkins joint being shown in Complainant's Exhibit No. 21 (Record, just preceding page 1555).

This matter of the joints alone rendered the machine perfectly useless, and since in this matter Mr. Hill deliberately disobeyed the patent and knew by experience what the consequence of his disobedience would be, it would be absurd to attribute to Mr Tilghman the defects due to his disobedience.

The mixing device.

Mr. Hill first tried a churn-dasher with holes in it, such as is described in the patent, and found that it required a *great deal of power to make a proper emulsion;* having established this *fact* he took away the churn and gave two men a stick apiece and told them to paddle around in the barrel of fat and water (see Hill, pages 1301–2).

Nothing is clearer in Mr. Tilghman's patent than the importance which he attaches to the mixture, and for the coil apparatus he directs that this mixing be carried to its extreme point, viz., till the fat and water are *emulsionized.* And besides this he recommends that perforated diaphragms should be placed in the coil itself to aid in keeping up the mixture.

Mr. Hill tried the device recommended by the patent for making the emulsion, and found, as he might have known, that it *required* a great deal of power to make a good mixture, so he insured a poor mixture by taking away Mr. Tilghman's emulsionizing machinery altogether, and getting a couple of men to paddle around in a barrel of fat and water. Of course he did not use the diaphragms suggested in the patent.

The Pump.

Mr. Hill at great length describes the difficulty he had with his pump. It is very probable that very hot water, or equally hot fat, would soften and destroy the usefulness of such a cup leather as he used. The only requirement of the specification or of common sense, is that the fat should be fluid, and

that does not require a high degree of heat. It is proved that similar cup leathers in hydraulic jacks filled with oil, are used without injury for years, although often exposed to the summer sun which would heat them far above the melting point of fat. (Jones, pages 1484–85, Qs. 14 to 21.)

If then, Mr. Hill had this requisite skill and knowledge to enable him to intelligently work this machine, he grossly misused his knowledge by deliberately heating his fat and water to a degree that he knew would cause trouble. If he did not know this, he was certainly incompetent to direct the experiment. Mr. Hill's elaborate pretense that there would in practice be any difficulty in keeping the fat and water at an innocuous heat, without watching, is simply absurd. And even if a cup leather would last but a few days, as he *guesses*, all trouble from this cause would be obviated by the simple expedient of having two pumps, one of which could be used while the leather of the other was being renewed.

The delivery valve.

It is probable that the leaking of the delivery valve, which Mr. Hill speaks of (page 1320), was caused by the scale from the new pipes of the coil. This trouble would last but a short time, and would do no harm while it lasted. It is the function of this valve to *leak*, at a *certain pressure*, and unless it then leaked faster than the pumps forced in at the other end of the coil, its leaking would do no harm.

Defects of defendants' coil did not exist in Mitchell's, and are creations of the experts.

It should be noticed, that the trouble which Mr. Hill had with the pump, the joints, the valve and the mixer, are peculiar to him. Mr. Mitchell also built a coil, and in doing so *found no trouble from any of the causes which Mr. Hill makes so much of;* but, having the same object in view, his *experts* (?) managed to secure other defects, which, although different, were as good for their purposes. And the two coils built by Mr. Tilghman, and the operation of which were observed by men of the highest scientific and practical attainments, never exhibited any of the defects of Mr. Hill's machine.

Operation of defendants' coil.

The testimony as to the manner in which this coil was operated, displays a continuation of the elaborate misconception of plain directions and studied stupidity which were the guiding principles in its construction.

AS TO THE EMULSION.

A great mistake was made by Mr. Hill in his churn, described in pages 1301-2. The specification says, page 9, "I place the fat or oil in a fluid state in the vessel A, with "from one-third to one-half its bulk of warm water, the disk "or piston B, perforated with numerous small holes, being "kept in rapid motion up and down in the vessel A causes "the fat or oil and water to form an emulsion or intimate "mechanical mixture." The drawing shows A to be a cylindrical vessel with a close fitting piston B. When moved up or down all the liquid in the length of the stroke would be forced in fine rapid jets through the holes into the liquid beyond so as to ensure intimate mixture of very finely divided particles.

Instead of copying this simple but *vitally important* machine, Mr. Hill took a common 42 gallon barrel, which like all barrels was several inches larger in diameter in the middle than at the ends. This shape of course would render impossible any close fit in the piston, to be moved up and down. He appears to have first tried some sort of piston or churn dasher with holes in it, driven by the steam engine, but gave it up, because "*it was surprising the amount of power the thing took, and it could not be worked by men fast enough to maintain the mixture.*"

He then used two sticks, 12 x 3, with vertical handles in the middle, worked by two men. Their total cross section, 72 square inches, was but about one-fifth that of the barrel, 23 diameter, and even these had *no holes* in them.

Such a contrivance would evidently make no *emulsion*, but a rough momentary mixture that would separate at once.

Dr. Dudley, a witness for defendants, on page 1338, × Q. 3 and 4, states that the mixture issuing from the coil "*some-*

"*times would contain a great deal of water, and at other times it* "*would be quite thick with very little water.*" He says this was the case in all three of the trials he witnessed, viz.: March 24th, May 3d, May 11th.

President Morton, page 1440, × Q. 196, says *he* did not notice any such irregularity of flow in the only operation he witnessed, that of May 11th; but his want of observation cannot be weighed for a moment against the positive assertion of so candid and straightforward a witness as Dr. Dudley, as to a fact recurring on *all three* trials.

The specification (pages 9 and 10) points out the importance of the fat and water remaining in the state of intimate mixture, all through the operation. The variation of the product, one sample "containing a great deal of water," and another sample "quite thick with very little water," is of itself, sufficient to account for an imperfect decomposition.

It is what would naturally occur from the coarse style of mixing applied. To make an emulsion or "mechanical mix-"ture having a milky appearance of oil and water," requires that the particles of each fluid should be very finely divided and evenly mixed together. It then has considerable permanence, and will remain for some time with very little separation. If the fluids are merely broken up into coarse drops and these mixed together, they separate rapidly.

Time of Treatment.

In proceeding to "develope" his coil apparatus, Mr. Hill makes at the outset a radical mistake as to the meaning of the specification; he says, page 1296:—

> "After determining that it (the coil) should be 500 feet in "length, we then adopted the language of the specifica-"tion that the emulsion should be ten minutes in transit "through the coil, or, perhaps, a little clearer would be "to say, every ten minutes during the operation of it we "should discharge one coil full, and as this coil repre-"sented 1200 cubic inches, our discharge was fixed for "1200 cubic inches for every ten minutes. Now Mr. "Tilghman says, in his testimony in answer to Q.

"14, on page 1015 (new record, page 1159), I believe "it is, that that sized coil would work 100 pounds "an hour, which is at variance with his specification; "because if it worked 100 pounds an hour, it would be "exposed to more than ten minutes in the coil and be "subject to some of the *objections that he notes*—one is the "*possibility of burning, I believe, if it is exposed too long;* "and we, therefore, adopted the terms of the specification, "which was ten minutes to discharge a quantity equal "to the internal volume of the coil—that is, so much of "the coil as was located in the furnace. And we have "termed this a coil capable of decomposing 133 * pounds "of fat per hour."

The specification says (page 9 of Rec.), "Although the de- "composition of the neutral fats by water takes place "with great quickness at the proper heat, yet I prefer that "the pump C should be worked at such a rate in propor- "tion to the length or capacity of the heating tubes D D, "that the mixture while flowing through them should *be* "MAINTAINED *at the desired temperature for ten minutes* be- "fore it passes into the refrigerator or cooling parts "H H of the apparatus.

"The melting point of lead has been mentioned as the prop- "er heat to be used in this operation." * * *

Now it is clear that the mixture must first be heated up to the temperature of melting lead, in order that it may be maintained at that temperature for ten minutes. How much time would be required for this heating up, is not mentioned in the specification, because it was not possible to state it definitely, as it would vary in each coil according to the proportion of surface exposed to the fire.

But whatever time was necessary was to be given, and then when the mixture had reached the desired temperature it was to be *maintained* at *that temperature* for ten minutes. Mr. Hill has entirely misunderstood this, and seems to have supposed that the only thing required, was, that the mixture should be ten minutes in *passing through* the coil, and that during *some*

* This 133 is a misprint for 138 pounds, as appears page 1303.

part of the ten minutes it should be raised to the temperature of melting lead.*

This is evidently a mistake; the plain meaning is that during the whole of the ten minutes the mixture should be maintained at the temperature of melting lead. The mixture would have a heat of about 110° Fahrenheit, when it entered the coil and therefore required to receive 502° of additional heat before it reached the desired temperature of 612° Fahrenheit. It could only receive this heat from the coiled tube, and whatever time was occupied in this preliminary heating up, must be deducted from the ten minutes allowed by Mr. Hill for its entire passage.

In the testimony of Mr. Tilghman, above referred to, he reckons that a 500 foot tube of ½ inch bore would be capable of decomposing 100 pounds of fat per hour; that is, that in one hour it would not only heat 100 pounds of fat and its proper dose of water up to 612° F., but it will also allow each particle of the mixture to remain at that temperature for 10 minutes. By Mr. Hill's calculation (page 1303), his 500 foot coil, when full, contained 23 pounds of fat and its dose of water. Therefore, to pass 100 pounds of fat and its dose of water in one hour ($\frac{100}{23}$=4.347) the coil must be filled and emptied 4.347 times, or it must retain each charge ($\frac{60}{4.347}$ =) 13.8 minutes. This will allow 3.8 minutes for the time of heating up, and 10 minutes for the time of digestion or maintenance at the proper heat.

Considering that the maximum heat allowed for the metal envelope of the coil is only some 20 or 30° Fahrenheit over 612° Fahrenheit, 3.8 minutes does not seem an unreasonable time to heat 23 pounds of fat and 10¼ pounds of water, from 110° Fahrenheit to 612° or to give it 502° of additional heat. But as Mr. Hill proposed to pass this quantity of mixture through his coil every 10 minutes, the 3.8 minutes required for heating it up to the desired temperature, would leave only

* The anxiety of defendants' experts to prevent any chance of a good decomposition in their coil is shown by their rushing the mixture through the coil in *ten minutes*, even when the heat was below lead melting—a clear disobedience of the *clear* directions of the patent.

6.2 minutes for the digestion and maintenance at that temperature, instead of 10 minutes as directed in the specification.

In the operation of May 3d (page 1308), the quantity of emulsion pumped in (337.75 pounds in one hour 53 minutes), is equal to 200 pounds per hour, or just the quantity required to allow 6.2 minutes for the time of maintenance at the proper heat.

But in the operation of May 11th (page 1311), the quantity pumped in was 416 pounds in one hour 37 minutes, which is equal to 257.3 pounds per hour, or 29 per cent. more than the 199.5 pounds per hour intended by Mr. Hill.

This additional quantity of cold mixture coming into the coil, took a proportionate time and length of tube to become heated up, and of course diminished in the same ratio, the time during which the mixture was maintained at the proper heat. By Mr. Hill's original mistake, this time was reduced from 10 minutes to 6.2, and the further reduction of 29 per cent. on this would leave only 4.4 minutes instead of the 10 mentioned in the patent.

These calculations are only approximate. We don't know where the leakage took place in the coil; probably more or less at each one of the 25 screw joints. A portion of the mixture pumped in probably leaked out before it got fully heated up to 612°, and would then cease to abstract any more heat from the coil. But making every allowance for this, it is clear that the mixture issuing from the exit valve cannot have had more than $\frac{1}{2}$ to $\frac{2}{3}$ of the stipulated time at the proper heat, and could not be expected even if everything else was right to show more than about that proportion of a complete decomposition.*

---

*What Hill accomplished by so constructing his coil that it would leak at each of its twenty-five or more joints, Mitchell also accomplished by the simple device of so arranging his exit valve that whenever it opened it remained open till sometimes the whole contents of the coil (the mixture which had been in it for ten minutes, and the raw tallow just pumped in) was shot out together. Shillito, page 390, × Q. 7.

"× Q. 7. How frequent were these irregular discharges, and what "quantity was discharged at any one time?

"A. 7. The time varied somewhat. I did not time its various dis-

Mr. Hill gives (page 1296) his reasons for not following Mr. Tilghman's estimate that a 500 feet coil would decompose 100 pounds fat per hour,

"Because, if it worked 100 pounds per hour, it would be "exposed to more than ten minutes in the coil and be "subject to some of the *objections that he notes*—one is "the possibillity of burning, I believe, if it is exposed "too long." * * *

Now there is not a word in Mr. T's testimony, or in the specification, about any objections to the mixture being exposed more than ten minutes in the coil, or about the possibility of burning, if exposed too long. It is a pure imagination of Mr. Hill, and it shows how little attention he gave to the subject, so that he not only neglected plain directions, but also actually invented misdirections.

General Remarks.

Without exhausting the subject, enough has been said to point out the absolute disregard of clear directions, both as to the construction and operation of the coil. That they should fail in obtaining a good decomposition, or rather that they should succeed in obtaining an imperfect decomposition by the means employed was a matter of course. The astonishing thing is that so much decomposition took place as the analysis shows.

Mr. Hill's evidence is to the effect that his coil leaked at every one of its 28 or 30 joints, both inside and outside of the furnace, and that burning fat makes a bad smell is a matter of general information. It is not surprising then that the smell became unbearable where they were burning fat on so large a scale. How the product of the machine came to have this odor might be explained in many ways.

In brief it was the consequence of their disregard of Mr. Tilghman's plain directions, which, when followed, result in a product thoroughly decomposed and fitted for manufacturing use, as is proved by the evidence of those gentlemen who saw

"charges. The apparatus was working, and *it would be, perhaps, "some ten or fifteen minutes before a discharge, and then it would "relieve itself, and then there would be another interval.*"

it in London, and by Professors Booth, Rogers, and Bridges, who themselves tested it in Philadelphia.

It is upon the evidence of these gentlemen that this court on the former appeal decided that the coil was a practicable apparatus, and certainly nothing has been shown before the master which should lead it to doubt the correctness of its former decision.

To sum up: It is decided that the coil apparatus will practically make fat acids and glycerine, when constructed and operated as specified. It is not, and cannot be disputed that if the coil will produce commercial products it is a more economical apparatus, and has a greater capacity than any that have been used. (See Tilghman's calculations, page 1159.)

Why has it not been universally used? Mr. Tilghman explains the ignorant fear of the pressure employed with which he was met. And, after all, what did it matter? The difference between one apparatus and another is a difference of fuel required, of labor, and of the quanity of product in a given time. In any apparatus, with which what this Court calls the "*sine qua non*" of the patented process (the intimate mixture) was provided for, the patented process was better in all these respects than the old process, and the great savings—the lime and acid, and the great gain—the glycerine, accrued to the users of all the different machines. Some used Melsen's complicated machine and were satisfied; some used Wright & Fouche's machine, and were satisfied; some, like Ropes and Price's Co., used horizontal digesters with paddles, and were satisfied; some used upright digesters with pumps, and were satisfied; and Mr. Werk was satisfied with his peculiar machine.

The gain of the process worked in any way was so great, that the differences in the economy of the various machines was, in comparison, nothing.*

* The saving of the important items—lime, sulphuric acid, and glycerine, is the same, whatever form of apparatus is used.

The only other items of expense are labor and fuel, and these are so small that the saving of even a large proportion of them would still be a trifling matter.

From Mr. Parkinson's interpretation of Mr. J. N. Gamble's statement,

Some other Matters of Fact.

As in this case nothing is considered settled by the defendants, and when the decision of this court has not prevented them from arguing before the master and the lower court the very points decided against them on the former appeal, it may be that they will refer in their argument to some of the theories advanced by their experts, and which were afterwards dropped, or apparently dropped, as untenable.

In view of this possibility, and also because they furnish a most valuable gauge of the competency and honesty of the experts, we will briefly refer to some of the facts developed.

Steam Distillation of Fats.

An elaborate attempt was made by the defendants to set up the process known as "the steam distillation process," as a standard of comparison more favorable to them in expense than the lime saponification process.

This process also played a large part in the main case where it was referred to by the defendants as being an anticipation of Mr. Tilghman's invention.

---

pages 1343-4, one man's day's labor is required for each 4470 pounds fat worked (instead of 8940 pounds as stated in complainant's brief before the master, page 22).

At Mr. Gamble's estimate ($10 per week), a day's labor would cost $1.66, and this would amount to $0.0372 cents for each one hundred pounds fat worked.

Averaging Mr. Gamble's figures, page 1466, the coal costs $0.0235 cents for each one hundred pounds fat worked, making for labor and fuel together $0.0607 cents for each one hundred pounds fat worked.

Supposing that a coil apparatus could make a saving of twenty-five per cent. of the labor and fuel required in a digester apparatus, it would amount to only $0.0151 cents for each one hundred pounds fat worked. For this slight extra saving it was not worth while to contest the prejudices against very high pressures.

The savings of lime, sulphuric acid, and glycerine, as proved, amount to $1.43 for each one hundred pounds fat worked, so that the saving of chemicals resulting from the use of the *process*, irrespective of the form of apparatus, amounts to nearly a hundred times as much as any saving likely to be made by the use of one form of apparatus rather than another.

What this process is.

In brief, this process consisted in the injecting of superheated steam into a vessel containing heated neutral fat, and in collecting and cooling the vapors distilled from it.

In our brief on the former appeal the relevancy of this process as an anticipation will be found fully discussed, and in addition there is a review of the evidence which shows that this process was an utterly impracticable one; *a mere chemical curiosity.*

This court found that this process, irrespective of its practicability, was not an anticipation of the complainant's invention.

Testimony of Endemann and Morton.

Messrs. Endemann and Morton brought this process again into the case, apparently with a view to showing that it was a better process than the old lime process. They constructed a little apparatus shown in the drawing (Defendants' Exhibit 29; Record, page 1554), and with this apparatus they made a number of experiments; and they testified that they had analyzed the product of these experiments, and found them to be *pure fat acid.*

On the strength of these tests and analyses, they testified to the perfect practicability of the process, and criticised with great severity the testimony given in the main case by Professor Booth and by Mr. Tilghman, to the effect that this process could not be practically applied in the arts, and could not be made to produce practically pure fatty acids.

Inherent weaknesses of testimony.

The conditions as to temperatures and management of the apparatus necessary to be observed during these experiments were such as would be practically impossible on a manufacturing scale. Neither Morton or Endemann had provided themselves with any facts which would go to show how great would be the cost of such a process to the manufacturer, or whether it could be carried on with sufficient speed to be practically operated; and these omissions did not occur from any want of opportunity or facilities for ascertaining them;

for these defendants, and probably every other candle manufacturer in the country, had been using *for many years* in their works distilling apparatus fitted in every way for the practice of this process, if practiced it could be.

Practicability of process disproved by complainant.

Endemann and Morton were both examined in chief on this subject in Cincinnati, and Dr. Endemann was cross-examined on the subject at great length, it being agreed that Professor Morton's cross-examination should take place at a later date. Before leaving Cincinnati, Mr. Emery, a large manufacturer of that city, was, by agreement, called in behalf of the complainant, and examined on the subject of a practical attempt which he had made twenty-five years ago to apply this steam distillation process to practical use. His testimony substantiated that of Mr. Tilghman's and Professor Booth, to the effect that this method was absolutely impracticable. (See Emery, Record, pages 1487 and 1491, 2, 3.)

Defendants' experts admit that their testimony was false.

When the master held his session in New York for the purpose of continuing Professor Morton's examination, Mr. Endemann again appeared and was put on the stand to say that his former most positive testimony as to the perfection of the product obtained by this distillation method was based purely on his imagination; that he not only had never obtained such a result of analysis as he swore to and based his testimony upon but he had absolutely never made any analysis of the product at all; and on page 1386, Q. 6, he makes a wholesale recantation of all his testimony on the matter of distillation by steam. When asked to explain this astounding conflict between the long and circumstantial testimony which he had before given on this subject and the fact which he now admitted, Dr. Endemann states (page 1387, Q. 9), that he did not consider the matter of importance; and when asked (Q. 10) whether the non-importance of the fact, in his opinion, justified him in deliberately misstating it, he replies (page 1387), that *he did not know it was untrue*. In fact, it would appear that Dr. Endemann's ignorance on the whole

subject was so profound. that, so far as he knew, anything *might have been* true in regard to it.

The testimony of Professor Morton, following this of Endemann's, and beginning on page 1388, is an exhibition of that gentleman's remarkable and squid-like powers of enveloping himself in obscurity on the approach of danger. In his direct testimony in Cincinnati, as to the matter of steam distillation of fats, he speaks of *his* distillation experiments, of *his* verifications of Dr. Endemann's analysis of the products, and of *his* results of analysis; stating them slightly different from those of the other chemist; and he draws conclusions and formulates theories on the basis of these analyses with a boldness and freedom thoroughly characteristic. On coming upon the stand, *after Endemann's retraction*, Professor Morton admits that he also had *never made any analysis* of any distillation products whatever.

The consistency of this statement with his former testimony and the value and reliability of any testimony from this witness, can be fully appreciated and gauged by his cross-examination (pages 1396 to 1399); commenting upon which, on our part, would be indeed to paint the lily. As to the bearing of all this testimony on the steam distillation process itself, it leaves it just where it found it in the testimony of Professor Booth and Mr. Tilghman, an utterly impracticable process; a mere chemical curiosity.

Lime Saponification under Pressure.

What is known of it.

In 1849 there appeared in the Encyclopædia Roret an article in which the difficulties and imperfections of the lime process as practiced in open tubs, is discussed; the author pointing out that while 9½ pounds of lime were *theoretically* sufficient to saponify 100 pounds of fat, yet in practice manufacturers found it necessary to use more than 15 pounds of lime; and then proceeding to make speculative suggestions as to how the proportion of lime "could be reduced "more nearly to the proportion indicated by theory." He first suggests that a more vigorous stirring would "accelerate

"and render more complete the combination of the lime with "the fat acids * * * also permit us to diminish the pro- "portion of this base."

But he follows this suggestion by admitting that the increase of power necessary to stir more vigorously, might very possibly cost even more than the saving in lime and acid.

The author, next briefly reviewing the development of the art, states that in the beginning it was supposed that lime saponification could only be carried on in closed boilers, and that the process of saponifying in open tubs, then in use, was a later discovery, and he suggests "that it is quite possible" that by returning to the old method a diminution of the lime required might be effected, but goes on to say that this idea was not new, as it had been repeatedly suggested and tried, "*and we do not know why it has been abandoned.*"

He then, as an example of this old, *abandoned* method, quotes from the specification of the Milly and Motard patent of 1834.

Review of Morton's testimony as to Roret article.

The only consideration which seems to have had the least influence with Professor Morton in giving his testimony is whether a theory could be *stated* with a sufficient degree of specious plausibility, and the subtleness with which he misstates facts in conflict with his ingenious theories, and imagines facts in support of them is by this time familiar to the court.

But in his reference to this Roret article (Qs. 18 to 20, page 1364), he fairly outdoes himself, for if ever there was a cunningly devised piece of Jesuitical casuistry, his smooth-flowing testimony as to the "gradual reduction" from 14 per cent. to 1 per cent. of lime, is that thing.

Following the suggestions of the Roret article, says this *expert*, the world at large would have gone on step by step decreasing the proportion of lime, &c., until the art arrived at its present condition.

As the court knows it is necessary to use a much larger percentage of lime than is theoretically necessary to saponify

a given quantity of fat. The writer of the Roret article speculates as to whether *this excess* cannot be diminished by saponifying at high heats. But the idea of decomposing the fats by means of anything *less* than the chemical equivalent of lime, is not in the remotest degree suggested or hinted at. This even Morton is compelled to acknowledge, but he says the "intelligent operative" *would have* decreased the lime and got good results, *would have* decreased it again and found no harm, and thus *would have* finally passed the line and discovered that water would supply the place of a part of the chemical equivalent of lime, and last of all, *would have* discovered that water alone was all that was necessary.

This is very plausible and sound, but answered, first, by the fact that *it did not take place*, and, secondly, by the fact that *it could not take place*.

The lime saponification under pressure was about the first process employed, and at that time, as Grasselli states (Record, page 554, Q. 2), they used from 20 to 24 per cent. of lime; this process was, as the Roret writer states, *abandoned* for open tubs long before the time he wrote. DeMilly and others had suggested it, and the writer was interested in their plan, and speculates as to its theoretical advantage, and the reason why it had been abandoned.

This reason was the very simple one, that *it was impracticable*, and the first step of the follower of the Roret article, so far from leading him *on*, as Professor Morton says, would have led him to go back to his open tubs and his 14 or more per cent. of lime, for he would have found that the rapid solidification of the whole mass prevented the necessary agitation of the charge, and that a quarryman was necessary to get the stuff out of his digester.

Jury Report, Record, page 1037.

"We have seen above that in 1834 Messrs. DeMilly and "Motard tried to saponify tallow by lime and water, "heating the mixture in a digester up to the temperature "of 136° C. (30 pounds pressure). The *solidification* of the "calcareous soap, a product which *prevented a suitable* "*agitation* of the mixture, and other reasons which we

"have already set forth, and to which it is useless to re-
"turn, caused the employment of this method to be *given*
"*up*. Last year (1854) M. DeMilly resumed this process,
"but by *changing completely* all the conditions of the op-
"eration."

It will be seen then, that it was after twenty years' abandonment that the use of pressure in saponifying fats was suddenly resumed, *per saltum*, by DeMilly, and then only as a disguise, under which he might steal the results of Tilghman's patent.

In the case against Werk, Mr. Collier, afterwards his counsel and the counsel and guarantor of these defendants, was the master appointed by the court, and among the questions referred to him was this very question as to the practicability of lime saponification under pressure.

After conducting a series of experiments Mr. Collier reported to the court that the process was *impracticable*.

See his report (Record, page 644).

The importance of these reports and of the Roret article lies in the fact that they compose all the evidence as to the practicability of this lime saponification under pressure, and they all agree that it cannot be practically used. No one witness pretends that he ever did use it, or knew of its being used.

Amount of Royalty.

The amount of royalty which the defendants would have paid if they had not been tempted by Mr. Werk's guarantee to infringe the patent is not, if our view of the law is correct, very material, as it is unquestionably less than the gains, savings, &c., of defendants, and hence is not the measure of recovery.

Defendants, however, except to this master's finding as to the amount, for the reason that, as they allege, the rate reported by him included other inventions and was only partly chargeable to this patent.

This assumption of defendants is utterly without basis of fact. The license contract appended to the bill of complaint shows that the royalty was reserved solely on the patent in controversy.

COMPLAINANT'S TITLE.

Defendants' objection to the complainant's title to recover in this suit is based on Mr. B. C. Tilghman's testimony to the effect that his services as his brother's agent were compensated by a percentage of the amounts collected. Aside from the fact that an objection to the complainant's title comes too late at this stage of the case, the objection itself is trivial and unsound.

There is no pretense that Mr. B. C. Tilghman has any assigned or written interest *in the patent*, or any equitable interest *in the patent*, and it is obvious that he could not have been joined as a co-complainant.

Mr. Tilghman's brother's interest in the matter is exactly such a one as his child might have if he had promised her a new doll if he won his case.

It might be supposed that this point of law was novel, but we find that defendants' counsel cannot claim the credit of first raising it, for it was before Mr. Justice Strong, in *Jordan* vs. *Dobson*, 4 Fisher's P. C., 236, where it is thus disposed of:—

> "I need not say that an interest in the net proceeds of collections under a patent does not necessarily amount to legal ownership in the patent itself. It is plain, therefore, as the case appears, that there has been no want of joinder of the necessary parties."

See also *Wallace* vs. *Holmes*, 5 Fisher's P. C., 37.
Aiken vs. *Dolan*, 3 Fisher's P. C., 187.

Respectfully submitted,

GEORGE HARDING,
FRANCIS T. CHAMBERS,
Of counsel.

Analytical Index.

	PAGES.
STATEMENT OF THE CASE,	1 to 37
How the record is made up,	1
THE PATENT, HOW CONSTRUED BY THIS COURT,	2 to 7
THE INFRINGING PROCESS,	7 to 13
How described in answer,	7 to 9
How considered by this court,	9 to 13
As to apparatus,	9 to 10
As to use of a little lime,	10 to 11
As to heating by steam,	11 to 12
As to temperature,	12
Conclusion of this court,	12 to 13
THE INTERLOCUTORY DECREE,	13 to 14
PROCEEDINGS BEFORE THE MASTER,	15 to 34
Account taken as directed in Mowry *vs.* Whitney,	15 to 16
Complainant's testimony,	16 to 28
The standard of comparison,	16 to 17
Savings in lime and acid,	17 to 19
Gain in glycerine,	19 to 24
Quantity, density and value of defendants' glycerine,	19
Quantity and density of old process glycerine,	19 to 20
What defendants would have got by old process,	20 to 21
Comparative quantity of glycerine by old and new process,	21 to 22
Cost of concentrating old process glycerine,	22 to 23
Calculation of gain in glycerine,	23
Calculation favorable to defendants,	23 to 24
Savings in fat,	24 to 26
Saving in cost of working,	27 to 28
What complainant requested the Master to report,	28
Defendants' testimony,	29 to 30
The Master's Report in brief,	30 to 34
The complainant's exceptions in brief,	34 to 35
The defendants' exceptions in brief,	35 to 36
THE FINAL DECREE,	36 to 37
ASSIGNMENT OF ERRORS,	38 to 42

THE ARGUMENT.

PROPER MEASURE OF DEFENDANTS' LIABILITY, ... 43 to 63
Conflict between interlocutory and final decrees, ... 43
Circuit Court really decided that damages only can be recovered, ... 43
Accounting for profits the settled practice in equity, ... 43 to 53
Act of 1870, ... 43 to 45
Principles of equitable rule, Rubber Company *vs.* Goodyear, ... 45 to 46
The equitable rule uniform and firmly established Mowry *vs.* Whitney; Mevs *vs.* Conover; The Cawood cases; Birdsall *vs.* Coolidge; Root *vs.* Railway Co.; Thomson *vs.* Wooster; Birdsell *vs.* Shaliol; Penn *vs.* Bibby, . . 46 to 53
Alleged severity of equitable rule as applied to this case, . . . 53 to 63
Pretence that defendants have not actually received profits, both immaterial and unfounded, ... 53 to 54
Pretence that defendants were excusably and honestly mistaken, 55 to 61
Infringement began four years before Mitchell case and when five judges had sustained the patent, ... 55
The true history of the infringement, ... 56 to 61
Defendants originally infringers, ... 56
Defendants' apparatus erected by patentee after settlement, ... 56
Cancellation of license, ... 56
Complainant's ground for suspecting conspiracy, ... 56
Complainant alleges conspiracy in bill, ... 57
Specific denial of conspiracy, ... 58
Conspiracy with Werk fully proved, ... 58 to 61
Conclusion, ... 61 to 63

COMPLAINANT'S EXCEPTIONS TO THE MASTER'S REPORT.

Large profits a proof of importance of the invention not a reason for treating this patentee more severely than others, ... 63 to 64
METHOD OF THE ACCOUNT CORRECT, ... 64
THE MASTER'S ERROR IN COMPUTING THE CHEMICAL SAVING, ON THE ALLEGED AVERAGE USE OF LIME AND ACID BY OTHERS INSTEAD OF THE PROPORTIONS ACTUALLY USED BY DEFENDANTS, ... 65 to 72
Facts as use of lime by old process, ... 65 to 70
Theoretical combination of lime and fat acids, ... 65
Excess of lime necessary, ... 65
Why necessary, ... 65 to 68
What governs the excess used in practice, ... 68
Testimony as to lime used, ... 68 to 69
Conclusion, Master should have found a use of 14 per cent. of lime by old process, ... 69 to 70

Facts as to use of acid by old process, ... 70 to 71
Conclusion.—Reasons why defendant's use of 14 per cent. of lime and 42 per cent. of acid should have been adopted as standard of old process by Master, ... 71 to 72

THE MASTER'S ERROR IN REPORTING THAT DEDUCTIONS SHOULD BE MADE FROM DEFENDANTS' CHEMICAL SAVINGS BY REASON OF THEIR ALLEGED USE OF MODIFICATIONS OF COMPLAINANT'S PROCESS,* . . . . . 72 to 104
If water process practicable defendants' savings are due solely to its use, ... 72 to 73
Only possible to dispute chemical savings by claiming that water alone is insufficient, ... 73
Defendants fully appreciated this and denied practicability of water process without the alleged modifications of 1 per cent. lime, and use of water in two doses, ... 73 to 74
Opinion of this court as to "modifications," 74
What defendants undertook to prove, ... 74 to 80
How they treated the old proofs, ... 74 to 75
How they cited the literature of the art, ... 76
How they tested the question by practical experiments, 77 to 80
Conclusions of experts, ... 78 to 80
Complainant's reply, ... 80 to 101
The old proofs, ... 80 to 86
Defendants' experts contradict not only eminent chemists but practical manufacturers, ... 80 to 81
Their ignorance of facts in record, ... 81
Facts shown them—how treated, ... 81 to 85
Complete proof of practicability of water process by Mitchell's use . . . . . 85 to 86
"*The literature of the art*" . . . . . 86 to 89
Defendants' experts refer to but four books and misquote them, ... 86 to 87
Fraudulent suppression of clear proof of practicability of the water process, ... 87 to 89
Defendants' experiments, ... 89 to 97
Made to conceal facts, not to show them, ... 89 to 91
How defendants' expert Morton explains why he made irrelevant experiments, ... 91 to 93
Morton's plan to make tests relevant by bringing in the coil, ... 93 to 95
His forgetfulness in framing his theory, ... 95
Morton swears that 1 per cent. of lime will make a difference of 12 per cent. in extent of decomposition, ... 96

* This same subject is discussed in greater detail on pages 105 to 148.

Defendants' counsel proposes to *test* the truth of Morton's testimony, ... 96 to 97
The July tests actually prove that the defendants derived no benefit from using lime and changing water, ... 98 to 99
Conclusion.—No logical excuse for not finding all the chemical savings to be due to the patented process, ... 99 to 101
The Master's error in reporting that the use of the patented process by Mitchell was not competent evidence in this case, and that said process had never been regularly used without modification in such apparatus as defendants', ... 101 to 104
The Master finds Mitchell's use irrelevant because his apparatus was not the same as defendants', ... 101
Why Mitchell's use should be considered, ... 101 to 102
Defendants' experts acknowledge Mitchell's use to be relevant 102
Apparatus used by defendants and by Mitchell practically identical, ... 102 to 103
Comparison of process as used by Mitchell and by defendants 103
Evidence cited by Master less relevant than Mitchell's use, . . 104
Evidence as a whole proves practicability of unmodified water process, ... 104

FALSE ISSUES AS TO THE CHEMICAL SAVINGS RAISED BY DEFENDANTS AFTER THEIR DEFENSE HAD BROKEN DOWN, ... 105 to 148
Defendants change position after July tests, ... 105
Confusions, misrepresentations, and suppressions of fact in Morton's tabulation of July tests, ... 105 to 106
Tabulation of facts connected with July tests omitted or misstated in Morton's tabulation of July tests—Defendants' Exhibit No. 15, ... 107
Morton's testimony after July tests—analysis of his answer to Q. 191, ... 109 to 116
New issues which Morton attempts to bring into this case, . . 116 to 117
THE MASTER'S MISTAKE IN REPORTING THAT THE USE OF LIME AND OF THE DOUBLE DOSE OF WATER WERE EFFICIENT MODIFICATIONS OF THE PATENTED PROCESS, . . . 117 to 137
He disregards the true, and accepts the false issue, ... 117
Review of the evidence in detail, ... 117 to 135
Object, and nature of evidence cited by Master from main case Record, ... 117 to 118
Essential requirements of complainant's process, ... 118
Conditions of process to some extent interchangeable, . . 118
Conditions recommended by patentee, ... 118
Why modified in practice and with what results, ... 118 to 120
(*a.*) Temperature, ... 118 to 119
(*b.*) *Intermixture of fat and water*, ... 119 to 126

Neglect of patentee's directions as to intermixture fully explains pretended failure of process, ... 119
Baujard's evidence, ... 119 to 120
Importance of intermixture shown by July tests, ... 120 to 126
Apparent anomaly in tabulation of tests, ... 120
Explained by unnoted fact as to intermixture, ... 121
Digestion No. 1 only relevant as to importance of intermixture, ... 121
Digestion No. 2 also useless for comparison because of irregular pump speed, ... 121 to 122
Pump speed regular only in digestions Nos. 3, 4, 5, and 6, 122
But other irregularities giving unfair advantage to digestions with lime, ... 122 to 123
No difference in results despite irregularities, ... 123
Results of imperfect intermixture, ... 123 to 124
Use of alkali a well-known means for effecting intermixture, ... 124
Use of lime mere mechanical equivalent for mechanical mixing, ... 125
Action of lime in promoting intermixture accounts for apparent advantage from its use in some of old tests. It was of uo use as defendants used it, ... 125 to 126
Defendant's use of lime not only useless, but injurious, . . 126 to 129
Where lime is used old and new process go on together, . 127
One-tenth of defendants' decomposition effected by old process unnecessarily, ... 127
Items of unnecessary expense incurred by use of lime, . . 127 to 128
Conclusions as to use of lime, ... 128 to 129
Did defendants derive advantage from using the water in two doses, ... 129 to 136
What is practically good decomposition, ... 129 to 131
Relation between analysis and good decomposition, . . . 131 to 133
Self-contradiction by defendants as to quantity of water used, ... 133
Relation of proportionate quantity of water to process, . . 133
Utility of two doses rather than one a practical question, . 133 to 134
How it might be tested, ... 134 to 135
July tests prove that no practical advantage was gained by double dose of water, ... 135
July tests demonstrate that defendants derived no advantage from their use of lime and of a double dose of water, . 136 to 137

THE MASTER'S MISTAKE IN REPORTING THAT THE PRODUCT OF THE WATER PROCESS WAS INFERIOR TO THAT OF THE OLD LIME PROCESS, ... 137 to 144
No evidence as to chemical perfection of decomposition by old process, ... 138

Character of old process such that its product would naturally be less pure than that of water process, ... 138
Two experiments made by defendants show decomposition by old process to be very imperfect, ... 138 to 139
Morton's "way of looking at it."
Before July tests, ... 139
After July tests, ... 139 to 144

Concluding remarks as to the chemical savings, the lime and acid, and the errors of the Master concerning them, ... 144 to 148
What the July tests, Mitchell's use and Cloetz' test prove—use of lime foolish, ... 146
Origin and vitality of mistaken idea as to utility of lime, . . . 146 to 147
Other pretended modifications of complainant's invention, . . 147 to 148

DEFENDANTS' GAIN IN GLYCERINE AND THE MASTER'S ERROR IN (*a*) REFUSING TO ALLOW THE COST OF CONCENTRATING THE OLD PROCESS SOLUTION TO THE DENSITY OF THAT OBTAINED BY THE NEW PROCESS, AND (*b*) REPORTING THAT THE GLYCERINE SOLUTION OF THE OLD PROCESS WAS DOUBLE IN BULK THAT OF THE NEW PROCESS, ... 149 to 152
The Master's error as to the quantity of defendants' glycerine, 149
Correction of Master's error as to quantity of defendants' glycerine, ... 149 to 150
The Master's error as to the cost of concentrating, ... 150 to 152

THE MASTER'S ERROR IN REPORTING THAT THERE WAS NO MATERIAL ECONOMY IN THE OPERATING COST OF THE INFRINGING PROCESS, OVER THE OPERATING COST OF THE OLD PROCESS, ... 152 to 153
CORRECTIONS IN THE FIGURES OF THE ACCOUNT RENDERED NECESSARY BY THE CORRECTION OF THE MASTER'S ERRORS, ... 153 to 154

AS TO INTEREST ON THE PROFITS, ... 154 to 155

ARGUMENT FOR COMPLAINANT AS APPELLEE, . . 156 to 185
THE SUBSTANCE OF DEFENDANTS' CASE.
THE COIL APPARATUS, ... 156 to 177
Questions as to coil formerly before this court, ... 157 to
Bearing of coil on construction of patent, ... 157 to 158
Practicability of coil apparatus, ... 158
The decree, ... 159

Possible relevancy of coil in accounting, ... 159
In fact, testimony about coil absolutely irrelevant to account, . 159 to 160
Defendants' contention as to coil, ... 160
The efficiency of the coil apparatus counsel say is the measure of the efficiency of the process as patented—Our reply, . . 160 to 164
What the patent says as to the coil, ... 161
Patent omitting reference to the disclaimed apparatus, ... 161 to 163
No invention in defendants' apparatus, ... 163 to 164
So held by this court, ... 164
Evidence as to coil, properly excluded by the Master, ... 164
Defendants' contention as to coil not only irrelevant but without basis of fact, ... 164 to 177
Evidence in the old record, ... 165
How disposed of by this court, ... 165
What the opinion means, ... 165 to 166
New testimony on the account—Proctor and Gamble's coil apparatus, ... 166 to 177
Construction of defendants' coil, ... 167 to 170
The joints, ... 167 to 169
The mixing device, ... 169
The pump, ... 169 to 170
The delivery valve, ... 170
Defects of defendants' coil did not exist in Mitchell's, ... 170
Operation of defendants' coil, ... 171 to 177
As to the emulsion, ... 171 to 172
Time of treatment, ... 172 to 176
General remarks, ... 176 to 177

SOME OTHER MATTERS OF FACT.

STEAM DISTILLATION OF FATS, ... 178 to 181
What this process is, ... 179
Testimony of Endemann & Morton, ... 179
Inherent weakness of testimony, ... 179 to 180
Practicability of process disproved by complainant, . . . 180
Defendants' experts admit that their testimony was false, 180 to 181

LIME SAPONIFICATION UNDER PRESSURE, ... 181 to 184
What is known of it, ... 181 to 182
Review of Morton's testimony as to Roret article, . . . 182 to 184

AMOUNT OF ROYALTY, ... 184

COMPLAINANT'S TITLE, ... 185

Supreme Court of the United States

No 25.

OCTOBER TERM—1880.

RICHARD A. TILGHMAN,
vs.
WILLIAM PROCTOR, et al.

Appeal from the Circuit Court of the United States, for the Southern District of Ohio.

OPINION

DELIVERED BY Mr. JUSTICE BRADLEY.

GEORGE HARDING,
Counsel for Appellant.

MATT. H. CARPENTER,
CHARLES B. COLLIER,
Counsel for Appellees.

BURK & M'FETRIDGE, PRINTERS 704 CHESTNUT ST. PHILADA.

Supreme Court of the United States.

No. 25.—October Term, 1880.

Richard A. Tilghman, Appellant, *vs.* William Proctor, James Gamble, W. A. Proctor, James N. Gamble and George H. Proctor.	Appeal from the Circuit Court of the United States for the Southern District of Ohio.

A patent for a process, irrespective of the particular mode or form of apparatus for carrying it into effect, is admissible under the patent laws of the United States.

To sustain a patent for a process, the patentee should be the first and original inventor of the process, should claim it in his patent, and, if the means of carrying it out are not obvious to an ordinary mechanic skilled in the art, his specification should describe some mode of carrying it out which will produce a useful result.

If a subsequent inventor discover a new mode of carrying out a patented process, though he may have a patent for such new mode, he will not be entitled to use the process without the consent of the patentee thereof.

The decision in Mitchell *vs.* Tilghman, 19 Wall. 287, reviewed and overruled; and Tilghman's patent, relating to the manufacture of fat acids, sustained as a patent for a process.

The decision in O'Reilly *vs.* Morse, 15 How. 62, and in the case of Neilson's Patent for the hot blast, (Webster's Reports,) commented upon and explained.

Mr. Justice BRADLEY delivered the opinion of the Court.

This case involves a consideration of the same patent which was the subject of litigation in the case of Mitchell *vs.* Tilghman, reported in 19th Wallace, 287. The evidence in the present case, which is quite an unwieldy mass, is much the same as in that, being supplemented, however, by the testimony of the patentee respecting the nature of his original experiments and the practicability of using profitably the coil apparatus described in the patent, together with certain exhibits relating to the novelty of the alleged invention. Upon the renewed consideration which has been given to the subject, the Court is unanimously of opinion, contrary to the decision in the Mitchell case, that the patent of Tilghman must be sustained as a patent for a process, and not merely for the particular mode of applying and using the process pointed out in the specification, and that the defendants have infringed it by the processes used by them.

The patent in question relates to the treatment of fats and oils, and is for a process of separating their component parts so as to render them better adapted to the uses of the arts. It was discovered by Chevreul, an eminent French chemist, as early as 1813, that ordinary fat, tallow, and oil are regular chemical compounds, consisting of a base which has been termed glycerine, and of different acids, termed generally fat acids, but specifically, stearic, margaric and oleic acids. These acids, in combination severally with glycerine, form stearine, margarine and oleine. They are found in different proportions in the various neutral fats and oils; stearine predominating in some, margarine in others, and oleine in others. When separated from their base (glycerine), they take up an equivalent of water, and are called free fat acids. In this state they are in a condition for being utilized in the arts. The

stearic and margaric acids form a whitish semi-transparent, hard substance, resembling spermaceti, which is manufactured into candles. They are separated from the oleic acid, which is a thin oily fluid, by hydrostatic or other powerful pressure; the oleine being used for manufacturing soap, and other purposes. The base, glycerine, when purified, has come to be quite a desirable article for many uses.

The complainant's patent is dated the third day of October, 1854, and relates back to the ninth day of January of that year, being the date of an English patent granted to the patentee for the same invention. It has but a single claim, the words of which are as follows:

"Having now described the nature of my said invention, and the manner of performing the same, I hereby declare that I claim, as of my invention, the manufacturing of fat acids and glycerine from fatty bodies by the action of water at a high temperature and pressure."

In the case of Mitchell the majority of the Court was of opinion that in the application of the process thus claimed, the patentee was confined to the method of using the process particularly pointed out in the specification; and as, by that, it was proposed to produce a very rapid separation of the fatty elements by the use of a high degree of heat; the operation being effected in the space of ten minutes by forcing the fat, mixed with water, through a long coil of strong iron tube passing through an oven or furnace where it was subjected to a temperature equal to that of melting lead, or 612 degrees Fahrenheit; it was concluded by the Court that the producing of the same result in a boiler subjected to only 400 degrees Fahrenheit, and requiring a period of several hours to effect the desired separation was not an infringment of the patent, although the process by which the effect was produced, namely, the action of water, in intimate mixture with the fat, at a high temperature and under a sufficient

pressure to prevent the formation of steam, was undoubtedly the same. On further reflection we are of opinion that, in the case referred to, sufficient consideration was not given to the fact that the patent is for a process, and not for any specific mechanism for carrying such process into effect.

In order to have a clearer understanding of the question it is necessary to advert briefly to the history of the art, and then to examine the terms of the patent in greater detail.

It is conceded by the complainant that two different processes for effecting a decomposition of fats into their component elements had been in practical operation prior to his invention. These processes were called respectively the alkaline saponification process, and the sulphuric acid distillation process. The first consisted of the manufacture of the fat into soap by the use of lime or other alkali; and then, of the decomposition of the soap, so produced, into the fat acids by the aid of hydrochloric or dilute sulphuric acid. The decomposition of the fat was, by subsequent improvement, effected by distillation in an atmosphere of steam. The other process, called the sulphuric acid distillation process, consisted of the direct saponification of fat by means of concentrated sulphuric acid, and the subsequent distillation over of the resulting fatty acids. By this process, however, the glycerine was destroyed.

The first of these processes was patented by Gay Lussac & Chevreul in 1825, but was not brought into successful operation in the manufacture of stearic candles until improved by De Milly, in 1831. The second process was proposed and developed between 1840 and 1850. It was extensively used during and after that period by the large manufacturing firm of E. Price & Co., of London, and their successors, Price's Patent Candle Company. Mr. G. F. Wilson, one of the shareholders in that establishment, and apparently a man of accurate knowledge on this subject, read various papers illustrative of the history of the manu-

facture, before learned societies in England, extracts from which are contained in the record, and throw considerable light on the matter. It appears from his statements that the distillation of the saponified fat, whether saponified by an alkali, or by sulphuric acid, was often accompanied by prejudicial effects from the access of atmospheric air to the contents of the still. To remedy this he and his associates adopted and patented the introduction of super-heated steam into the still or vat containing the fat acids, which excluded atmospheric air, and carried over the fatty vapors into the receiver in a more perfect condition than they had before been able to obtain them. These patents were taken out in 1843. In the following year, the same parties, Gwynne and Wilson, found, what Dubrunfaut had found two or three years before, that palm oil, which is very fusible and manageable, can be distilled in its crude state, in the manner last described, that is, by the introduction of steam into the still, without the intervention of saponification; and the distilled product being then steam-boiled in water, acidulated with sulphuric acid, and the water allowed to settle and separate, the resulting substance would be a fat acid It is not shown that this process was ever carried into successful operation prior to Tilghman's patent; and judging from what was done by the Price Patent Candle Company in the way of improvement immediately after becoming acquainted with Tilghman's process, it is to be inferred that the steam-distillation process (without saponification) was still an unsuccessful experiment when his patent was issued. This experiment, however, must be regarded as the nearest approach to the process of Tilghman of anything done in the art prior to it.

We do not regard the accidental formation of fat acid in Perkin's steam cylinder from the tallow introduced to lubricate the piston (if the scum which rose on the water issuing from the ejection pipe was fat acid) as of any consequence in this inquiry. What

the process was by which it was generated or formed was never fully understood. Those engaged in the art of making candles, or in any other art in which fat acids are desirable, certainly never derived the least hint from this accidental phenomenon in regard to any practicable process for manufacturing such acids.

The accidental effects produced in Daniell's water barometer and in Walther's process for purifying fats and oils preparatory to soap making, are of the same character. They revealed no process for the manufacture of fat acids. If the acids were accidentally and unwittingly produced, whilst the operators were in pursuit of other and different results, without exciting attention and without its even being known what was done or how it had been done, it would be absurd to say that this was an anticipation of Tilghman's discovery.

Nor do we regard the patent of Manicler, which was taken out in 1826, as anticipating the process of Tilghman. It is true that he directs a mixture of fat with about one-quarter of its weight of water to be placed in a boiler, and subjected to a heat sufficient to create a pressure equal to one atmosphere above the natural atmospheric pressure [or about 250° Fahrenheit]; the boiler being provided with a safety-valve which would secure that degree of pressure. But, subject to this pressure, the patent directed that the mixture should be made to boil, and of course that the water should be converted into steam: the words are, "apply fire to this digester to melt and digest the contained tallow or fat and water and keep up a rapid ebullition during about six hours." It is probable, therefore, that any decomposition of the fat which may have been produced by this process was due to the steam formed and passing through the fat, as no means appears to have been adopted for keeping up the mixture of the fat and water. But we have no evidence that the process was ever successful in practice. One of the defendants' witnesses testifies that he tried it, and though he got

some results, he adds this pregnant observation: "To transform all the fat in this way at so low a temperature would have required many days." He only pretends that the sample which he obtained showed by its appearance, as well as by its acid action, that the separation had commenced. Evidently, therefore, this was but an abandoned experiment, since we never hear any more of it from 1826 down to the trial of this cause.

It is unnecessary to examine in detail other alleged anticipations of Tilghman's process, We believe that we have specified the most prominent and reliable instances.

Tilghman's discovery was made in 1853, and was, in brief, this: That the fat acids can be separated from glycerine, without injury to the latter, by the single and simple process of subjecting the neutral fat whilst in intimate mixture with water, to a high degree of heat under sufficient pressure to prevent the water from being converted into steam, without the employment of any alkali or sulphuric acid, or other saponifying agent; the operation, even with the most solid fats, being capable of completion in a very few minutes when the heat applied is equal to that of melting lead, or 612° Fahrenhit; but requiring several hours when it is as low as 350° or 400° Fahrenheit. The only conditions are, a constant and intimate commixture of the fat with the water, a high degree of heat, and a pressure sufficiently powerful to resist the conversion of the water into steam. The result is, a decomposition of the fatty body into its elements of glycerine and fat acids, each element taking up the requisite equivalent of water essential to its separate existence, and the glycerine in solution separating itself from the fat acids by settling to the bottom when the mixed products are allowed to stand and cool. In this process a chemical change takes place in the fat in consequence of the presence of the water and the active influence of the heat and pressure upon the mixture.

We are satisfied that Tilghman was the originald iscoverer of this process. His priority was acknowledged at the time, by those most interested to question it. Mr. Wilson, to whose statements reference has been made, and who is perhaps more justly entitled than any one else to claim an anticipation of Tilghman's discovery, makes no such pretension; but, on the contrary, concedes Tilghman's right to priority; and, indeed, Price's Patent Candle Company, of which Mr. Wilson was a member and director, took a license under Tilghman's English patent.

As having some bearing upon the proper construction of the patent in suit (which will presently be more particularly examined), it is proper to observe, that Tilghman's actual invention, as demonstrated in his experiments made in 1853, before making any application for a patent, was not confined to the use of a coil of pipe in a heated chamber or furnace for effecting the process which he claims; but was frequently exhibited by using a simple digester, filled nearly full with a mixture of fat and water, and heated in a gas stove, or in a vertical position over a gas lamp; the mixture of fat with the water being kept up by a loose metallic rod, or jumper, which thoroughly mixed the contents when the digester was shaken. Sometimes the digester was heated in a horizontal position, and being provided with thin copper partitions fixed inside, was made to revolve in order to cause a more perfect mixture of the materials. In using the digester, it not being provided with a safety-valve, a small space was left at the top for the formation of sufficient steam to prevent, by its elasticity, the vessel from exploding.

In making these experiments Tilghman not only varied the apparatus, but applied different degrees of heat in the operation. The following is his account of some of these proceedings. He says:

"Before applying for my patent I had made many experiments in decomposing by water at temperatures below melting bismuth, sometimes in the coil form of

apparatus, but most frequently in digesters. The lowest temperature tried by me was three hundred and fifty degrees Fahr. (350° F.), or 120 pounds pressure continued for four hours. The digester was as usual in a vertical position, but the heat was in this case given by an oil bath. I obtained both fat acids and glycerine in this experiment, but in such small quantities as to prove that though the decomposition did go on at that heat, yet it was very slow compared with the higher heats. I find notes of another experiment, July 15th, 1854, in the coil apparatus, with palm oil, made at the melting point of tin, 440° Fahr. 360 pounds pressure. It was pumped through the coil very slowly, so as to give about 30 minutes' heat, and found to be partly decomposed, so that it was returned to the inlet end of the apparatus and pumped through a second time at the same rate and heat, which produced perfect decomposition of the palm oil into fat acids and solution of glycerine. Ten minutes' exposure would have perfectly decomposed palm oil at the heat of melting bismuth, 510° F. Yet I found 70° lower heat required six times as long to produce the same effect. I had often decomposed tallow at 510° F. before taking out my patent, not in the coil apparatus, but in the simple vertical digester. In this case I had to allow increased time on account of the imperfect contact of the fat and water in addition to that required by the diminished temperature."

In the course of his testimony, Tilghman explains why, in his patent he specially recommended the use of the high temperature of melting lead in applying his process to practical use. He says :

"Many experiments had shown me that at these higher temperatures the decomposition was carried on with the greatest economy of fuel and cost of apparatus. When in London, in 1847, I had found Perkins' house-warming apparatus, consisting of coils of hundreds of feet of pipe, containing water at the temperature of melting lead, had long been in extensive domestic use

there. On returning to London, in 1853, I found the same apparatus largely used for heating bakers' ovens. As I thus found such heats and pressures were perfectly practical and safe, as well as economical, I thought I was bound to describe my invention in what I then believed to be the best mode of carrying it out, and that, as I was the discoverer of the chemical facts, I could then claim broadly as my process the use of water highly heated and under pressure to decompose fats, no matter what temperature or apparatus was used."

And being asked for his present view as to the practicability, economy, and safety of the higher temperatures as compared with lower temperatures, he said:

"I think the high-pressure apparatus is much more economical, both in the first cost and in the expense of working. Its principal disadvantage is that ordinary engineers are not familiar with its management, and consequently dislike it."

In December, 1853, Tilghman, having completed his experiments to his own satisfaction, filed a caveat in the Patent Office preparatory to taking out a patent for his invention. In this caveat, he says:

"The invention consists in subjecting animal and vegetable fatty and oily substances containing glycerine to a high temperature and pressure in close vesselst mixed with different agents, according to the effec, desired to be produced upon the fatty matter. Thus, when I wish to convert the neutral fatty substances into fatty acids and glycerine, I pump a mixture of the fat and water, under great pressure, through a series of strong metal tubes, kept at about the heat of melting lead, and provided with a cooling-worm and safety-valve at its outlet. The neutral fatty substance is decomposed by the process, and the fat acid and solution of glycerine which issue through the safety-valve separate by settling."

Tilghman soon after repaired to England and took out a patent there, dated the 9th day of January, 1854, and sealed the 25th of March. He immediately put in

operation an apparatus for exhibiting his process on a small scale. Mr. Wilson, before mentioned, witnessed his experiments and thus speaks of them in a paper communicated to the Journal of the Society of Arts, January 25, 1856 :

"In January, 1854, Mr. Tilghman an American chemist, who has studied all that has been published here and in France, on the subject of acidification and distillation of fatty bodies, obtained a patent for exposing fats and oils to the action of water at a high temperature and under great pressure, in order to cause the combination of the water with the elements of the neutral fats, so as to produce at the same time free fat acids and solution of glycerine. He proposed to effect this by pumping a mixture of fat and water, by means of a force pump, through a coil of pipe heated to about 612 Fahrenheit, kept under a pressure of about 2,000 pounds to the square inch; and he states, that the vessel must be closed, so that the requisite amount of pressure may be applied to prevent the conversion of water into steam. This is, all must admit, a beautiful, original, chemical idea, well carried out; it has yet to prove how far it can compete successfully with distillation. We have made an arrangement with Mr. Tilghman which will give us the means of testing its commercial merits."

Mr. Wilson goes on to state that this process of Tilghman suggested to them the idea of distilling fats by passing [steam] into them at a high temperature whereby to resolve them into glycerine and fat acids. They found the plan successful, and that the glycerine distilled over with the fat acids, but no longer combined with them; and, in July, 1854, they took out a patent for that process. In a paper read before the Glasgow meeting of the British Association for the Advancement of Science, in September, 1855, Mr. Wilson thus refers to the course of discovery which took place in this branch of manufacture :

"By our first improvement in separating the fat acids from neutral fats, the glycerine was decomposed by the direct action of concentrated sulphuric acid at a high temperature, and all that remained of it was a charred precipitate. A new process for decomposing neutral fats by water under great pressure coming under our notice" [referring to Tilghman's process] "led us to look again more closely into our old distilling processes, and the doing this showed, what we had often been on the brink of discovering, that glycerine might be distilled.

"In our new process the only chemical agents employed for decomposing the neutral fat, and separating its glycerine, are steam and heat; and the only agents used in purifying the glycerine thus obtained are heat and steam; thus all trouble from earthy salts or lead is escaped.

"Distillation, however, purifies the impure glycerine of the old sources.

"On the table is a series of products of palm oil, which will serve to illustrate the process. Steam, at a temperature of from 550° to 600° Fah., is introduced into a distillery apparatus containing a quantity of palm oil. The fatty acids take up their equivalents of water, and the glycerine takes up its equivalent; they then distill over together. In the receiver the condensed glycerine, from its higher specific gravity, sinks below the fat acids."

We quote more fully from this paper, because it is a cotemporary acknowledgment, made by a man who stood in the front rank of those who understood, and whose interest it was to understand, the most advanced process of resolving fats and oils into their component parts, that Tilghman's "process for decomposing neutral fats by water under great pressure" was "a new process;" and who, with his associates, took hints from it for making new departures and improvements in the art. The statements of Mr. Wilson on this subject are corroborated by other witnesses. Indeed,

nearly all those competent to speak on the subject state or admit, that the process of decomposing fats into glycerine and fat acids by mixing them with water and subjecting the mixture to a high degree of heat under a pressure sufficient to prevent the conversion of the water into steam, was not known in the arts prior to Tilghman's discovery. The testimony of some experts to the contrary is based upon their construction of certain patents and publications produced in evidence, the most important of which have already been adverted to.

The question then arises—Has Tilghman secured the exclusive right to the process of which he was thus the inventor?

An examination of the patent itself, which the preceding remarks will enable us better to understand, will show, we think, that it was intended to and does cover and secure to the patentee the general process which has been described, although only one particular method of applying and using it is pointed out.

The specification describes the invention as follows:

"My invention consists of a process for producing free fat acids and solution of glycerine from those fatty and oily bodies of animal and vegetable origin which contain glycerine as their base. For this purpose, I subject these fatty or oily bodies to the action of water at a high temperature and pressure, so as to cause the elements of those bodies to combine with water, and thereby obtain at the same time free fat acids and solution of glycerine. I mix the fatty body to be operated upon with from a third to a half of its bulk of water, and the mixture may be placed in any convenient vessel in which it can be heated to the melting point of lead, until the operation is complete. The vessel must be closed and of great strength, so that the requisite amount of pressure may be applied to prevent the conversion of the water into steam.

"The process may be performed more rapidly and also continuously by causing the mixture of fatty matter and water to pass through a tube or continuous channel, heated to the temperature already mentioned; the requisite pressure for preventing the conversion of water into steam being applied during the process; and this I believe is the best mode of carrying my invention into effect. In the drawing hereunto annexed are shown figures of an apparatus for performing this process speedily and continuously, but which apparatus I do not intend to claim as any part of my invention."

The specification then goes on to describe, by the aid of the drawing referred to, the particular device mentioned. But it is evident, and indeed is expressly announced, that the process claimed does not have reference to this particular device, for the apparatus described was well known, being similar to that used for producing the hot blast and for heating water for the purpose of warming houses. It consists of a coil of iron pipe, or other metallic tubing, erected in an oven or furnace, where it can be subjected to a high degree of heat; and through this pipe the mixture (of nearly equal parts of fat and water) made into an emulsion in a separate vessel by means of a rapidly vibrating piston, or dasher, is impelled by a force pump in a nearly continuous current, with such regulated velocity as to subject it to the heat of the furnace for a proper length of time to produce the desired result; which time, when the furnace is heated to the temperature of 612° Fahrenheit, is only about ten minutes. The fat and water are kept from separating by the vertical position of the tubes, as well as by the constant movement of the current; and are prevented from being converted into steam by weighting the exit valve by which the product is discharged into the receiving vessel, so that none of it can escape except as it is expelled by the pulsations produced by the working of the force pump. Before arriving at the exit valve, the pipe is passed, in a second coil, through an exterior

vessel filled with water, by which the temperature of the product is reduced. After the product is discharged into the receiving vessel, it is allowed to stand and cool until the glycerine settles to the bottom and separates itself from the fat acids. The latter are then subjected to washing and hydraulic pressure in the usual way.

After describing this apparatus it is added:

"Although the decomposition of the neutral fats by water takes place with great quickness at the proper heat, yet I prefer that the pump should be worked at such a rate, in proportion to the length or capacity of the heating tubes, that the mixture, while flowing through them, should be maintained at the desired temperature for ten minutes before it passes into the refrigerator or cooling part of the apparatus."

It is evident that the passing of the mixture of fat and water through a heated coil of pipe standing in a furnace is only one of several ways in which the process may be applied. The patentee suggests it as what he conceived to be the best way, apparently because the result is produced with great rapidity and completeness. But other forms of apparatus, known and in public use at the time, can as well be employed without changing the process. A common digester, or boiler, can evidently be so used, provided proper means are employed to keep up the constant admixture of the water and fat, which is a *sine qua non* in the operation. Tilghman himself, as we have seen, often used such digesters in making his experiments before applying for his patent; and, in putting up machinery for his licensees after his patent was obtained, he did the same thing when the parties desired it. Yet surely the identity of the process was not changed by thus changing the form of apparatus. No great amount of invention was required to adapt different forms of well-known apparatus to the application of the process. The principal difficulty would be in providing an in-

ternal arrangement in the boiler, or digester, for successfully keeping up the intimate commixture of the fat and water. It is evident that this could be accomplished by means of revolving reels armed with buckets, or of a force pump constantly transferring the heavy stratum of water from the bottom of the mass to the top, aided by horizontal diaphragms partially sectionizing the digester. These devices were resorted to by Tilghman and others when they used a boiler instead of a coil of pipe.

Whilst Tilghman in his patent recommends the high degree of heat named, he does not confine himself to that. It had been fully developed in his experiments, and was well known to him, that a lower degree of heat could be employed by taking longer time to perform the operation; and this would be necessary when boilers, or digesters, of considerable size were used instead of the coil of pipe, on account of the decreasing power of large vessels to resist the internal pressure. The specification, after describing the use of a metallic coil of pipe, proceeds to add:

"The melting point of lead has been mentioned as the proper heat to be used in this operation, because it has been found to give good results. But the change of fatty matters into fat acid and glycerine takes place with some materials (such as palm oil) at or below the melting point of bismuth [510° Fahr.]; yet the heat has been carried considerably above the melting point of lead without any apparent injury, and the decomposing action of the water becomes more powerful as the heat is increased. By starting the apparatus at a low heat, and gradually increasing it, the temperature giving products, most suitable to the intended application of the fatty body employed, can easily be determined."

Now, when we find it stated, as we do in this specification, that the patentee subjects "fatty or oily bodies to the action of water at a high temperature and pressure, so as to cause the elements of those bodies to combine with water;" that "the mixture may be

placed in any convenient vessel in which it can be heated to the melting point of lead, until the operation is complete;" that "the vessel must be closed and of great strength, so that the requisite amount of pressure may be applied to prevent the conversion of water into steam;" that "the decomposition of the neutral fats by water takes place with great quickness at the proper heat;" that "the melting point of lead has been mentioned as the proper heat to be used in this operation, because it has been found to give good results;" that "the change of fatty matters into fat acid and glycerine takes place with some materials at or below the melting point of bismuth;" that "the decomposing action of water becomes more powerful as the heat is increased;" that "by starting the apparatus at a low heat, and gradually increasing it, the temperature giving products most suitable to the intended application of the fatty body employed, can easily be determined;"—and when we find that the patentee categorically claims, in general terms, as his invention "*the manufacturing of fat acids and glycerine from fatty bodies by the action of water at a high temperature and pressure;*" and being satisfied that he was, in fact, the inventor of the general process described and bodied forth in the specification; how can we, by any fair rule of construction, circumscribe this claim in such a manner as that it shall only cover the process when applied in the use of a coil of pipe heated to 612° Farenheit? Or, if we allow it to embrace any "convenient vessel," and do not confine it to a coil of pipe, how can we confine it to a particular degree of heat? What did Tilghman discover? And what did he, in terms, claim by his patent? He discovered that fat can be dissolved into its constituent elements by the use of water alone under a high degree of heat and pressure; and he patented *the process* of "manufacturing fat acids and glycerine from fatty bodies by the action of water at a high temperature and pressure." Had the process been known and used before, and not been Tilghman's

invention, he could not then have claimed anything more than the particular apparatus described in his patent; but being the inventor of the process, as we are satisfied was the fact, he was entitled to claim it in the manner he did.

That a patent can be granted for a process there can be no doubt. The patent law is not confined to new machines and new compositions of matter, but extends to any new and useful art or manufacture. A manufacturing process is clearly an art within the meaning of the law. Goodyear's patent was for a process, namely, the process of vulcanizing India rubber by subjecting it to a high degree of heat when mixed with sulphur and mineral salt. The apparatus for performing the process was not patented, and was not material. The patent pointed out how the process could be effected, and that was deemed sufficient. Neilson's patent was for the process of applying the hot blast to furnaces by forcing the blast through a vessel or receptacle situated between the blowing apparatus and the furnace, and heated to a red heat; the form of the heated vessel being stated by the patent to be immaterial. These patents were sustained after the strictest scrutiny and against the strongest opposition.

On the subject of patents for processes, Mr. Justice Grier, in delivering the opinion of this court in Corning *vs.* Burden (15 How. 267), said:

"A process *eo nomine* is not made the subject of a patent in our act of Congress. It is included under the general term, 'useful art.' An art may require one or more processes in order to produce a certain result or manufacture. The term 'machine' includes every mechanical device or combination of mechanical powers and devices to perform some function or to produce a certain effect or result. But where the result or effect is produced by chemical action, by the operation or application of some element or power of nature, or of one substance to another, such modes, methods, or operations, are called processes. A new

process is usually the result of a discovery—a machine of invention. The arts of tanning, dyeing, making water-proof cloth, vulcanizing India rubber, smelting ores, and numerous others, are usually carried on by processes as distinguished from machines. One may discover a new and useful improvement in the process of tanning, dyeing, &c., irrespective of any particular form of machinery or mechanical device. And another may invent a labor-saving machine, by which the operation or process may be performed, and each may be entitled to his patent. As for instance: A has discovered that by exposing India rubber to a certain degree of heat, in mixture or connection with certain metallic salts, he can produce a valuable product or manufacture; he is entitled to a patent for his discovery, as a process of improvement in the art irrespective of any machine or mechanical device. B, on the contrary, may invent a new furnace, or stove, or steam apparatus, by which this process may be carried on with much saving of labor and expense of fuel, and he will be entitled to a patent for his machine as an improvement in the art."

Neilson's patent, above referred to, had some features very similar to those of Tilghman's. The strong objection urged against the latter is, that the particular apparatus described in the specification is not that which is generally used, and that it cannot be used with much profit or success in large manufacturing operations; whereas the slower method of dissolving fats in a common boiler, or digester, at a lower temperature even than that of melting bismuth, which is not described in the specification, is the one which is generally adopted. Precisely this circumstance existed in reference to the patent of Neilson. The specification directed that the blast or current of air produced by the blowing apparatus should be passed into an air vessel, or receptacle, heated to a red heat, and from thence into the furnace. Then, after stating that the air vessel, or receptacle, should be increased in size

according to the size of the forge or furnace to be supplied, the specification adds: "The form or shape of the vessel or receptacle is immaterial to the effect and may be adapted to the local circumstances or situation." Now the most simple and natural form of an air vessel for heating the blast, as here directed, would be a box or chamber, or a cylindrical vessel; but it turned out in practice that a receptacle of this kind would answer the purpose but very imperfectly; and that the best and most useful method was to heat the blast in a series of tubes placed in a heated oven. This was held to be no ground for invalidating the patent, or for preventing it from covering intermediate tubes, as well as an intermediate box or chamber, the jury being of opinion that a man of ordinary skill and knowledge in the construction of blowing and air-heating apparatus, would be able, from the information contained in the specification, to erect a machine which would answer some beneficial purpose in the application of the process; and would not be misled and prevented from so doing by the declaration that the form or shape of the vessel or receptacle was immaterial to the effect. In this view of the subject the patent was sustained after very great consideration.

Some question has, indeed, been made whether Neilson's patent was sustained as a patent for a process. The Court of Exchequer, in reviewing the proceedings at the trial, and answering the objection that it was a patent for a principle, said: "It is very difficult to distinguish it from the specification of a patent for a principle, and this at first created in the minds of some of the court much difficulty; but after full consideration, we think that the plaintiff does not merely claim a principle, but a machine embodying a principle, and a very valuable one. We think the case must be considered as if the principle being well known, the plaintiff had first invented *a mode of applying it* by a mechanical apparatus to furnaces; and his invention consists in this—*by interposing a receptacle for heated air*

between the blowing apparatus and the furnace. In this receptacle he directs the air to be heated by the application of heat externally to the receptacle, and thus he accomplishes the object of applying the blast, which was before of cold air, in a heated state to the furnace.'' —(Webster's Rep. 371.)

In this passage we think that the Court of Exchequer, (who spoke through Baron Parke,) drew the true distinction between a mere principle, as the subject of a patent, and a process by which a principle is applied to effect a useful result. That a hot blast is better than a cold blast for smelting iron in a furnace was the principle, or scientific fact, discovered by Neilson. And yet, being nothing but a principle, he could not have a patent for that. But having invented and practically exemplified a process for utilizing this principle, namely, that of heating the blast, in a receptacle, between the blowing apparatus and the furnace, he was entitled to a patent for that process although he did not distinctly point out all the forms of apparatus by which the process might be applied, having, nevertheless, pointed out a particular apparatus for that purpose, and having thus shown that the process could be practically and usefully applied. Another person might invent a better apparatus for applying the process than that pointed out by Neilson, and might obtain a patent for such improved apparatus; but he could not use the process without a license from Neilson. His improved apparatus would, in this respect, stand in a relation to the process analogous to that which an improvement on a patented machine bears to the machine itself.

That Neilson's patent was regarded as for a process is apparent from what is said by the judges who had it under consideration. Thus Baron Parke, at the trial, had said: "The specification and patent together make it clear what the discovery was: it was the introduction of hot air by means of heating it before it was introduced into the furnace, between the blowing

apparatus and the furnace."—(Webster, 312.) And when the matter came before the House of Lords, after a trial in Scotland, Lord Campbell said: "After the construction first put upon it [the patent] by the learned judges of the Court of Exchequer, sanctioned by the high authority of my noble and learned friend now upon the Woolsack, when presiding in the Court of Chancery, I think the patent must be taken to extend to all machines, of whatever construction, whereby the air is heated intermediately between the blowing apparatus and the blast furnace. That being so, the learned judge was perfectly justified in telling the jury that it was unnecessary for them to compare one apparatus with another, because, confessedly, that system of conduit pipes was a mode of heating air by an intermediate vessel between the blowing apparatus and the blast furnace, and, therefore, it was an infraction of the patent."—(Webster, 715.)

This case of the hot blast was commented upon in the great case of O'Reilly *vs.* Morse, reported in 15th Howard, 62, and is there recognized and approved in the opinion of this court delivered by Chief Justice Taney. After quoting the remarks of Baron Parke in the Court of Exchequer, cited above, the Chief Justice says: "We see nothing in this opinion differing in any degree from the familiar principles of law applicable to patent cases. Neilson claimed *no particular mode* of constructing the receptacle, or of heating it. He pointed out the manner in which it *might* be done; but admitted that it might also be done in a variety of ways; and at a higher or lower temperature; and that all of them would produce the effect in a greater or less degree; provided the air was heated by passing through a heated receptacle. . . Whoever, therefore, used this method of throwing hot air into the furnace, used *the process* he had invented, and thereby intringed his patent, although the form of the receptacle or the mechanical arrangements for heating it, might be different from those described by the patentee.

For whatever form was adopted for the receptacle, or whatever mechanical arrangements were made for heating it, the effect would be produced in a greater or less degree, if the heated receptacle was placed between the blower and the furnace, and the current of air passed through it. . . . The patent was supported, because he [Neilson] had invented a mechanical apparatus by which a current of hot air, instead of cold, could be thrown in. And this new method was protected by the patent. The interposition of a heated receptacle *in any form*, was the novelty he invented."—(15 How. 115, 116.)

We have quoted these remarks of the Chief Justice more fully because they show most clearly that he put the same construction upon Neilson's patent that was put upon it by Lord Campbell, and that he fully acquiesced in the legality and validity of a patent for a process. Yet it has been supposed that the decision in O'Reilly *vs.* Morse was adverse to patents for mere processes. The mistake has undoubtedly arisen from confounding a patent for a process with a patent for a mere principle. We think that a careful examination of the judgment in that case will show that nothing adverse to patents for processes is contained in it. The eighth claim of Morse's patent was held to be invalid because it was regarded by the court as being not for a process, but for a mere principle. It amounted to this, namely, a claim of the exclusive right to the use of electro-magnetism as a motive power for making intelligible marks at a distance; that is, a claim to the exclusive use of one of the powers of nature for a particular purpose. It was not a claim of any particular machinery, nor a claim of any particular process for utilizing the power; but a claim of the power itself,—a claim put forward on the ground that the patentee was the first to discover that it *could* be thus employed. This claim the court held could not be sustained.

That this was the true ground of the decision will be manifest from the following observations of the

Chief Justice in the opinion already quoted from. He says: "He [Morse] claims the exclusive right to every improvement where the motive power is the electric or galvanic current, and the result is the marking or printing intelligible characters, signs, or letters at a distance. If this claim can be maintained, it matters not by what *process or machinery* the result is accomplished. For aught that we now know some future inventor, in the onward march of science may discover a mode of writing or printing at a distance by means of the electric or galvanic current, without using any part of the process or combination set forth in the plaintiff's specification. . . . In fine he claims an exclusive right to use a *manner and process* which he has not described and indeed had not invented, and therefore could not describe when he obtained his patent. The court is of opinion that the claim is too broad, and not warranted by law. . . . It is the high praise of Professor Morse that he has been able by a new combination of known powers, of which electro-magnetism is one, to discover a method by which intelligible marks or signs may be printed at a distance. And for the method or process thus discovered he is entitled to a patent. But he has not discovered that the electro-magnetic current, used as a motive power, in any other method, and with any other combinations, will do as well." After reviewing the statutes and decisions bearing upon the subject, the Chief Justice makes a summary conclusion of the whole matter, as follows: "Whoever discovers that a certain useful result will be produced, in any art, machine, manufacture, or composition of matter, by the use of certain means, is entitled to a patent for it; provided he specifies the means he uses in a manner so full and exact that any one skilled in the science to which it appertains, can, by using the means he specifies, without any addition to or subtraction from them, produce precisely the result he describes. And if this cannot be done by the means he describes, the patent is void. And if

it can be done, then the patent confers on him the exclusive right to use the means he specifies to produce the result or effect he describes, and nothing more. And it makes no difference, in this respect, whether the effect is produced by chemical agency or combination; or by the application of discoveries or principles in natural philosophy, known or unknown before his invention; or by machinery acting altogether upon mechanical principles. In either case he must describe *the manner or process* as above mentioned, and the end it accomplishes. And any one may lawfully accomplish the same end without infringing the patent, if he uses means substantially different from those described." —(15 How. 119.)

It seems to us that this clear and exact summary of the law affords the key to almost every case that can arise. "Whoever discovers that a certain useful result will be produced in any art by the use of certain means is entitled to a patent for it, provided he specifies the means." But everything turns on the force and meaning of the word "means." It is very certain that the means need not be a machine, or an apparatus; it may, as the court says, be a *process*. A machine is a thing. A process is an act, or a mode of acting. The one is visible to the eye—an object of perpetual observation. The other is a conception of the mind, seen only by its effects when being executed or performed. Either may be the means of producing a useful result. The mixing of certain substances together, or the heating of a substance to a certain temperature, is a process. If the mode of doing it, or the apparatus in or by which it may be done, is sufficiently obvious to suggest itself to a person skilled in the particular art, it is enough, in the patent, to point out the process to be performed, without giving supererogatory directions as to the apparatus or method to be employed. If the mode of applying the process is not obvious, then a description of a particular mode by which it may be applied is sufficient. There is, then, a description of the process and of one practical mode in which it may be

applied. Perhaps the process is susceptible of being applied in many modes and by the use of many forms of apparatus. The inventor is not bound to describe them all in order to secure to himself the exclusive right to the process, if he is really its inventor or discover. But he must describe some particular mode, or some apparatus, by which the process can be applied with at least some beneficial result, in order to show that it is capable of being exhibited and performed in actual experience.

Let us apply these principles to the present case. In the first place, the claim of the patent is not for a mere principle. The chemical principle, or scientific fact, upon which it is founded is, that the elements of neutral fat require to be severally united with an atomic equivalent of water in order to separate from each other and become free. This chemical fact was not discovered by Tilghman. He only claims to have invented a particular mode of bringing about the desired chemical union between the fatty elements and water. He does not claim every mode of accomplishing this result. He does not claim the lime-saponification process nor the sulphuric-acid-distillation process, and if, as contended, the result was accomplished by Dubrunfaut, Wilson and Scharling, by means of steam distillation, he does not claim that process. He only claims the process of subjecting to a high degree of heat a mixture continually kept up, of nearly equal quantities of fat and water in a convenient vessel strong enough to resist the effort of the mixture to convert itself into steam. This is most certainly a process. It is clearly pointed out in the specification, and one particular mode of applying it and carrying it into effect is described in detail. But it is not the particular apparatus described which Tilghman desires to secure by his patent. Having pointed out the process and suggested a particular mode of applying it, he claims as his invention "*the manufacturing of fat acids and glycerine from fatty bodies by the action of water at a high temperature and pressure.*" The true construction of

this claim is to be sought by comparing it, as we have already done, with the context of the specification; with the statement of the patentee that his "invention consists of a *process* for producing free fat acids and solution of glycerine from those fatty and oily bodies of animal and vegetable origin, which contain glycerine as a base;" that "for this purpose he subjects these fatty and oily bodies to the action of water at a high temperature and pressure, so as to cause the elements of those bodies to combine with water and thereby obtain at the same time free fat acids and solution of glycerine;" that he "mixes the fatty body to be operated upon with from a third to a half of its bulk of water, and the mixture may be placed in any convenient vessel in which it can be heated to the melting point of lead" [which is afterwards explained to be only desirable for a quick result, not essential]; that "the vessel must be closed and of great strength, so that the requisite amount of pressure may be applied to prevent the conversion of the water into steam." This is the process which the patentee claims to have invented; and this description of it gives the proper construction and qualification to the claim.

It is objected that the particular apparatus described in the patent for carrying the process into effect cannot be operated to produce any useful result. We have examined the evidence on this point and are satisfied that it shows the objection to be unfounded. A recapitulation of this evidence is not necessary. The testimony of Tilghman himself, of Professor Booth and of Mr. Wilson is directly to the point.

It only remains that we should express our views on the question of infringement. The defendants advance several reasons for the purpose of showing that their process does not conflict with that of Tilghman. First, because they do not use the apparatus described in the complainant's patent; but use a boiler in which the charge of fat and other materials is placed and heated; and do not mix the fat and water in the manner pointed out in the specification of the patent, but, on the con-

trary, have inserted in the boiler a pump which forces the water as it settles to the bottom upwards to the top of the mass and pours it upon the upper surface, whence it again finds its way down through the fat, thus keeping up a constant mixture. It is unnecessary to add anything further on the subject of the form of the apparatus used. The patentee is not confined to a metallic coil of pipe heated in a furnace; but his patent extends to and embraces any convenient vessel for holding the mixture, which is strong enough to sustain the pressure necessary to prevent the water from being converted into steam. The defendants use such a vessel, and use it for the purpose indicated and pointed out in the patent. The vessel which they use has the requisite strength to prevent the water from being converted into steam, and does effect that object. And as to the defendants' using a different method from that suggested in the patent for keeping up the mixture of fat and water, that is of no consequence. The keeping up of the mixture is the important thing. That is a necessary part of the process. They employ such a device for effecting this as is adapted to the form of vessel in which they heat the material. Using a boiler instead of a coil of pipe, for this purpose, they are obliged to employ an additional, or modified means for keeping up the mixture. They only employ such means as, in view of the change adopted in the form of the heating apparatus, and of the known appliances in use in analogous processes, would naturally suggest themselves to a mechanic skilled in the art. Or, if the mode of effecting the continued mixture adopted by the defendants should be deemed a new and useful improvement, they might perhaps have a patent for that peculiar device without being entitled to use Tilghman's process, on which it is but an improvement.

Another ground on which the defendants argue that they do not infringe the patent is, that they do not, in their process, use water alone in admixture with fat, but use also some portion of lime: that they formerly used seven per cent. of lime, and now use four per cent.

But they do not use lime in the manner and to the extent in which it is used for dissolving fats by the saponifying process. That requires twelve or fourteen per cent. Even if the saponifying process partly takes place, they use Tilghman's process for effecting the balance of the operation. They use water in admixture with fat, heated to a high degree, far above the boiling point, and yet subjected to such pressure as to prevent the water from being converted into steam; and though they may also use other things at the same time, which other things may facilitate the operation, or render a less degree of heat necessary than would be required when water alone is used, and thus actually improve the process of Tilghman; yet this process is included in their operation, and forms the basis of it. It is idle, therefore, to say that they do not infringe Tilghman's patent. It is unnecessary to determine what precise part the lime used by the defendants plays in their process; whether, as the complainant contends, it saponifies the fat to a certain extent, leaving the remainder to be acted upon by the water alone purely after the process of Tilghman; or whether, as the defendants contend, the lime produces a more perfect and active commixture of the fat and water, or predisposes the fat to unite with the requisite elements of water necessary for producing glycerine and the fat acids; in either case the process of Tilghman, modified or unmodified by the supposed improvement, underlies the operation performed in the defendants' boilers.

Another ground assumed by the defendants to avoid the charge of infringements is, that they do not heat the mixed mass in the manner pointed out in Tilghman's specification; but, instead of heating the containing vessel by an outside application of heat, they heat the contents by the introduction of super-heated steam. But we think that this does not alter the essential character of the process. The heating by steam is clearly an equivalent method to that of heating by an external fire. The patent does not prescribe any particular method of applying the heat, except

when using the pipe and coil apparatus described in the specification: and, even in the use of this apparatus, the outward application of the heat to the pipe is suggested incidentally and as a matter of convenience rather than as an essential requisite. The patentee showed one method in which the heat could be applied. That was all that was necessary for him to do. If it could be applied in any number of different methods, it would not affect the validity of the patent as a patent for a process. The method of heating the mixture by the introduction of steam may be attended with some beneficial results, in producing an agitation, or automatic circulation helpful to the perfection of the admixture of the water and fat; and so far it may be an improvement on heating from without. Suppose this to be so, as before said, the introduction of an improvement gives no title to use the primary invention upon which the improvement is based.

Finally, the defendants argue that they only use a low degree of heat and pressure compared with that pointed out by the patent, namely, only about 310° Fahrenheit instead of 612°. The precise degree of heat, as we have seen, is not of the essence of the patent. The specification only claims that a high degree of heat, such as would be sufficient to melt lead, is most effective and rapid in producing the desired result; but suggests a trial of the apparatus employed with different degrees of heat so as to ascertain that which is best for each particular kind of fat. "By starting the apparatus," the language is, "at a low heat, and gradually increasing it, the temperature giving products most suitable to the intended application of the fatty body employed can easily be determined." It is probably true, as contended for by the defendants, that by the use of a small portion of lime, the process can be performed with less heat than if none is used. It may be an improvement to use the lime for that purpose: but the process remains substantially the same. The patent cannot be evaded in that way. The matter may be stated thus:—Tilghman discovers a

process of decomposing fats by mixing them with water and heating the mixture to a high temperature under a pressure that prevents the formation of steam. It is a new process, never known before. The defendants seeing the utility of the process, and believing that they can use a method somewhat similar without infringing Tilghman's patent, put a little lime into the mixture, and find that it helps the operation, and that they do not have to use so high a degree of heat as would otherwise be necessary. Still, the degree of heat required is very high, at least a hundred degrees above the boiling point; and a strong boiler, or vessel, is used in order to restrain the water from rising into steam. Can a balder case be conceived, of an attempted evasion, and a real infringement, of a patent?

And as to the low degree of heat used in the operations of the defendants, this must also be said: that, with the reduction of the temperature, the time of perfecting the operation is more than proportionally increased. Tilghman was aware of this result, and pointed it out in his patent. He expressly says: "The decomposing action of the water becomes more powerful as the heat is increased." What can be done in minutes by the application of a very high degree of heat, requires hours to do at the temperature used by the defendant. But the process is still the same, and the defendants fail to evade the patent.

We pass by the fact that the defendants first took a license from the patentee, and under it and under his directions, erected substantially the same apparatus which they are yet using. Receiving what they regarded as additional light, they refused to continue the payment of a royalty, and put the complainant to his legal remedy.

It is our opinion that the patent is for a process, that it is a valid patent, and that the defendants infringe it.

We have considered the case entirely upon its merits. It is unnecessary to bestow much discussion upon the technical objections that have been raised. They have not been pressed in the argument, and are probably not seriously relied on. One of them is, that no

replication was filed in the case. To this it may be answered, that the parties have throughout treated the case as though it were regularly at issue. The various stipulations into which they have entered, with regard to the admission of evidence to be heard on the trial of the cause, are totally inconsistent with the idea that the case was to be heard merely on bill and answer. Another objection is, that the patent was dated more than six months prior to the filing of the application for it. But under the law then in force (1854) with regard to the antedating of patents where a foreign patent had been obtained, this was admissible. The 6th section of the act of March 3d, 1839, entitled "An act in addition to an act to promote the progress of the useful arts," expressly declared, "that no person shall be debarred from receiving a patent for any invention or discovery . . . by reason of the same having been patented in a foreign country more than six months prior to his application: *Provided* that the same shall not have been introduced into public and common use in the United States prior to the application for such patent: *And provided also*, that in all cases every such patent shall be limited to the term of fourteen years from the date or publication of such foreign letters-patent." Now, we know by the proceedings on the application in this case that the attention of the Commissioner of Patents was expressly called to the fact of the issuing of the English patent, and that the question of the date of the patent in suit was submitted to and considered by him: under the laws then in force, he determined that the patent ought to be antedated as of the date of the English patent. It must be presumed that his decision was right according to the facts of the case, at least until the contrary is shown; and nothing has been shown to the contrary, by any evidence in the cause, to which our attention has been called.

The decree of the Circuit Court is reversed, and the cause remanded with directions to enter a decree in conformity with this opinion.

JAMES H. McKENNEY,
Clerk Supreme Court United States.

Circuit Court of the U. S.

SOUTHERN DISTRICT OF NEW YORK.

RICHARD A. TILGHMAN,
vs.
ROLAND G. MITCHELL. } In Equity.

UPON EXCEPTIONS TO THE MASTER'S REPORT.

OPINION OF JUDGE BLATCHFORD.

CIRCUIT COURT OF THE UNITED STATES,

For the Southern District of New York.

RICHARD A. TILGHMAN
vs.
ROLAND G. MITCHELL.

IN EQUITY. No. 1.

On Exceptions to the Master's Report.

The opinion of the Court was delivered, August 26th, 1871.

BLATCHFORD, J.—This case comes up on exceptions taken by the plaintiff to the report of the Master, filed February 7th, 1870. On the 1st of December, 1864, an interlocutory decree was made in the cause, on final hearing, by which it was referred to the Master to state and report to the Court an account of the gains and profits which the defendant had received, or which had arisen or accrued to him, from infringing the exclusive right, of the plaintiff, by the manufacture, use and sale of the improvements patented in the letters patent upon which the suit was brought. The bill was filed in 1862. It was founded on letters patent granted to the plaintiff, October 3d, 1854, for an "improvement in processes for

purifying fatty bodies." The term of the patent was for fourteen years from the 9th of January, 1854.

In his specification, the patentee says: "My invention consists of a process for producing free fat acids and solution of glycerine from those fatty and oily bodies of animal and vegetable origin, which contain glycerine as their base. For this purpose, I subject these fatty or oily bodies to the action of water, at a high temperature and pressure, so as to cause the elements of those bodies to combine with water, and thereby obtain at the same time free fat acids and solution of glycerine. I mix the fatty body to be operated upon with from a third to a half of its bulk of water, and the mixture may be placed in any convenient vessel in which it can be heated to the melting point of lead, until the operation is complete. The vessel must be closed and of great strength, so that the requisite amount of pressure may be applied, to prevent the conversion of the water into steam. The process may be performed more rapidly, and also continuously, by causing the mixture of fatty matter and water to pass through a tube or continuous channel, heated to the temperature already mentioned, the requisite pressure for preventing the conversion of water into steam being applied during the process; and this, I believe, is the best mode of carrying my invention into effect. In the drawing hereunto annexed, are shown figures of an apparatus for performing this process speedily and continuously, but which apparatus I do not intend to claim as any part of my invention." He then describes the construction of the apparatus shown by the figures in the drawing. The fat or oil, in a fluid state, is placed in a vessel with from one-third to one-half its bulk of

warm water, a disc or piston in the vessel, perforated with numerous small holes, being kept in rapid motion, up and down, in the vessel, to cause the fat or oil and water to form an emulsion or intimate mechanical mixture. A force pump, like those in common use for hydraulic presses, then drives the mixture through a long coil of very strong iron tube, which, being placed in a furnace, is heated by a fire to about the temperature of melting lead. From the exit end of the heating tubes, the mixture, which has then become converted into free fat acids and solution of glycerine, passes on through another coiled iron tube, immersed in water, by which it is cooled down from its high temperature to below 212° Fahrenheit, after which it makes its escape through an exit valve into a receiving vessel The specification says: "The iron tubes I have employed and found to be convenient for this purpose, are about one inch external diameter, and about half an inch internal diameter, being such as are in common use for Perkins' hot water apparatus. The ends of the tubes are joined together by welding, to make the requisite length, but, where welding is not practicable, I employ the kind of joints used for Perkins' hot water apparatus, which are now well known." The heating tube is coiled several times backwards and forwards, so as to arrange a considerable length of tube in a small space. The different coils of the tube are kept about a quarter of an inch apart from each other, and the interval between them is filled up solid with cast-iron, which also covers the outer coils or rows of tubes, to the thickness of one-half or three-quarters of an inch. This casing of metal insures a considerable uniformity of tem-

perature in the different parts of the coil, adding also to its strength, and protecting it from injury by the fire. The exit valve is so loaded, that, when the heating tubes are at the desired working temperature, and the force pump is not in action, such valve will not be opened by the internal pressure produced by the application of heat to the mixture; and, therefore, when the force pump is not in action, nothing escapes from the exit valve, if the temperature be not too high. But, when the pump forces fresh mixture into one end of the heating tubes, the exit valve is thereby forced open, to allow an equal amount of the mixture, which has been operated upon, to escape out of the cooling tubes at the other end of the apparatus. The specification adds: "No steam or air should be allowed to accumulate in the tubes, which should be kept entirely full of the mixture. For this purpose, whenever it may be required, the speed of the pump should be increased, so that the current through the tubes may be made sufficiently rapid to carry out with it any air remaining in them. Although the decomposition of the neutral fat by water takes place with great quickness at the proper heat, yet I prefer that the pump should be worked at such a rate, in proportion to the length or capacity of the heating tubes, that the mixture, while flowing through them, should be maintained at the desired temperature for ten minutes, before it passes into the refrigerator or cooling parts of the apparatus. The melting point of lead has been mentioned as the proper heat to be used in this operation, because it has been found to give good results. But the change of fatty matters into fat acids and glycerine takes place with

some materials (such as palm oil) at or below the melting point of bismuth. Yet the heat has been carried considerably above the melting point of lead without any apparent injury, and the decomposing action of the water becomes more powerful as the heat is increased. By starting the apparatus at a low heat and gradually increasing it, the temperature giving products most suitable to the intended application of the fatty body employed, can easily be determined. To indicate the temperature of the tubes "(the heating tubes)" I have found the successive melting of metals and other substances of different and known degrees of fusibility to be convenient in practice. Several holes, half an inch in diameter and two or three inches deep, are bored into the solid parts of the castings surrounding the tubes, each hole being charged with a different substance. The series I have used consists of tin, melting at about 440° F.; bismuth, at about 510° F.; lead, at about 610° F.; and nitrate of potash, at about 660° F. A straight piece of iron wire, passing through the side of the furnace to the bottom of each of the holes, enables the workman to feel which of the substances are melted, and to regulate the fire accordingly. It is important for the quickness and perfection of the decomposition, that the oil and water, during their entire passage through the heating tubes, should remain in the same state of intimate mixture in which they enter them. I, therefore, prefer to place the series of heating tubes in a vertical position, so that any partial separation which may take place while the liquids pass up one tube, may be counteracted as they pass down the next. I believe that it will be found

useful to fix, at intervals in the heating tubes, diaphragms, pierced with numerous small holes, so that the liquids, being forced through these obstructions with great velocity, may be thoroughly mixed together. I deem it prudent to test the strength of the apparatus by a pressure of ten thousand pounds to the square inch before taking it into use; but I believe the working pressure necessary in using the heat I have mentioned will not be found to exceed two thousand pounds to the square inch. When it is desired to diminish the contact of the liquids with iron, the tubes or channels of the apparatus may be lined with copper. The hot mixture of fat acids and glycerine which escapes from the exit valve of the apparatus separates by subsidence. The fat acids may then be washed with water, and the solution of glycerine concentrated and purified by the usual means. The fat acids thus produced may, like those obtained by other methods, be used in the manufacture of candles and soaps, and be applied to various purposes, according to their quality; and, when desired, they may also be first bleached by chemical agents, or purified by distillation, in a current of steam, or in a vacuum, as is now well understood. I prefer that the fatty bodies should be previously deprived, as far as practicable, of such impurities as would cause the discoloration of the fat acids produced, but, when the fat acids are to be finally purified by distillation, this preliminary purification is of less importance. When sulphuric acid, nitrous fumes, or other corrosive agent, shall have been used for purifying, hardening or otherwise preparing the fatty body to be operated upon, I take care that all traces of it shall be washed out or

neutralized, before passing it through the apparatus. Some fatty bodies (particularly when impure) generate, during the process, a portion of acetic or other soluble acid, which might tend to injure the iron tubes. In such cases, I add a corresponding quantity of alkaline or basic matter to the water and oil before they are pumped into the tubes." The claim is in these words: "Having now described the nature of my said invention, and the manner of performing the same, I hereby declare, that I claim as of my invention, the manufacturing of fat acids and glycerine from fatty bodies, by the action of water at a high temperature and pressure." The case was brought to a hearing before Mr. Justice Nelson, who, in November, 1864, delivered a written opinion, in which he said: "It will be seen, not only from the specification, but also from the claim, that the improvement patented to the complainant is the invention of a process for producing fat acids and glycerine from fatty or oily bodies, which process consists in the action of water upon these bodies at a high temperature and pressure, and which may be effected in any vessel adapted to such use. There is no claim for the vessel or machinery thus used; but, as it was essential to the validity of the process, as an invention, to show how it may be adapted to practical use, two modes are pointed out—one, any convenient vessel well known to the art, and which some of the witnesses called a digester; the other, the coil apparatus; in either of which, as appears from the proofs, the process could be carried into practical effect, according to our construction of the patent. It was urged, on the argument, by the learned counsel

for the defendant, that, upon the terms of the specification, the vessel must be entirely filled with the mixture of water and fatty matter, and then be closed, and the contents heated to the point of melting lead, and no steam be permitted to be made in the vessel; and that, upon this hypothesis, no vessel could be made of sufficient strength to endure the pressure. But we do not agree to this construction. In the first place, the degree of heat was given only as the maximum, and under which the process could be most rapidly carried into effect. For, the patentee, speaking upon this part of the specification, says, that no fixed degree of heat can be given, as the different fatty or oily substances that may be used will require different degrees; and that, by starting the vessel at a low heat and gradually increasing it, the best temperature may be ascertained for the particular substance used. In the next place, we cannot agree that a fair construction of the specification tends to the conclusion, either that the vessel was to be entirely filled, or that no steam was to be permitted in it. No doubt, it is true, as urged for the defendant, if thus filled, and the vessel closed, and the contents heated to the point of melting lead, or under a pressure that would prevent the existence of steam, the process would be utterly impracticable; and, doubtless, the patentee knew this would be the result, as well as any of the experts. It would require but the commonest knowledge and experience in the business of life to reach such a conclusion. This moderate degree of knowledge, at least, should be kept in view, in construing the general terms of the description. Besides, the patentee does not direct that the vessel should be en-

tirely filled. This is an inference of the learned counsel, from the direction that the vessel must be closed and be of great strength, so that the requisite amount of pressure be applied to prevent the conversion of the water into steam. Now, all that was intended, as is apparent from the context, by the patentee, was, that the pressure should be so great as to prevent the body of the water in the vessel from passing into steam, as the heated water was the element that separated the fatty acids and glycerine. That there would necessarily be some steam, must have been obvious to the patentee, as well as to any one of common observation. Now, upon this interpretation of the patent, and which, we think, is the sound one, we repeat what we have already said, that the process could and has been carried into successful operation by the means pointed out by the patentee. Previous to the date of this invention, there were but two modes known or in practical use for decomposing fatty substances, and obtaining from them fatty acids and glycerine—one called the lime saponification process; the other known as the distillation process. It is not material to give a particular description of these modes of separating the fatty acids and glycerine. It is sufficient to say that they were different from the patentee's in the process or mode of producing the result, much more expensive and tedious, and have generally gone out of use, both in this country and in England, since the complainant's improvement has become generally known and practised. We have looked through the proofs in the case with some care, and, without going into them, in this opinion, are satisfied that the complainant was the first person that discovered the chemi-

cal fact, that fatty or oily substances could be decomposed, and the fatty acids and glycerine separated, by the action of water at a high temperature and under pressure. Then, as to the infringement, it is not material to enquire whether the vessel or machinery used by the defendant is or is not similar to that described in the complainant's patent. These constitute no part of his invention. If the defendant, or the persons under whom he uses his machinery, have discovered new means of carrying into effect the complainant's process, he or they may be entitled to a patent for that improvement. But this would furnish no right to the use of the process. The question here is—does the defendant, whatever may be his vessel or machinery, manufacture or produce fat acids and glycerine, from fatty bodies, by the action of water at a high temperature and pressure, according to the process as explained by the plaintiff in his specification? We are satisfied that he does, and hence has infringed the patent. Our conclusion is, that the complainant is entitled to a decree for an injunction and profits."

Voluminous testimony was taken before the Master, on the reference made to him by the interlocutory decree, and his report is, "that no gains or profits have been proven to have been received by, or to have arisen or accrued to the defendant, from the manufacture, use or sale of the improvements patented in the letters patent set forth and described in the order of reference." The plaintiff excepts to the report of the Master, and alleges, in his exceptions, that the Master erred in not reporting the following facts as proved:

"1. That defendant has made a profit by the saving of the quantity of lime and sulphuric acid formerly used by him in his old process, to produce the fat acids and glycerine which he now produces (without using lime or sulphuric acid) by the action of water at a high temperature and pressure.

2. That the quantity of lime and sulphuric acid thus saved by defendant, is thirteen and a half pounds of lime, and twenty-seven pounds of sulphuric acid, on each one hundred pounds of fat decomposed into fat acids and glycerine, by the action of water at a high temperature and pressure.

3. That defendant has made a profit by the saving of the quantity of fat formerly lost and thrown away with the refuse sulphate of lime produced in his old process, but which fat is no longer lost since his use of complainant's process, in which no refuse sulphate of lime is produced or thrown away.

4. That the quantity of fat thus saved by defendant, is two pounds on each one hundred pounds of fat decomposed into fat acids and glycerine by the action of water at a high temperature and pressure.

5. That the quantity of fat decomposed by defendant into fat acids and glycerine, by the action of water at a high temperature and pressure, up to the 9th day of January, 1868, amounted to eleven million five hundred and two thousand, eight hundred and ninety-two pounds, (11,502,892 lbs).

6. That the saving of thirteen and a half pounds of lime, twenty-seven pounds of sulphuric acid, and two

pounds of fat, upon each one hundred pounds of fat decomposed, was made and realized by defendant upon the said eleven and a half million pounds of fat decomposed into fat acids and glycerine.

7. That the values or market prices of the lime, sulphuric acid and fat, at the several dates when saved by defendant, are those stated by him in his testimony herein.

8. That defendant has made a profit by the increased strength, purity and value of the glycerine obtained by his use of complainant's process, as compared with that obtained by his former process.

9. That this increase of value of the glycerine amounts to one-fifth of a cent on each pound of fat from which the glycerine was utilized and obtained, by the action of water at a high temperature and pressure

10. That the quantity of fat from which the glycerine was utilized and obtained by defendant, by the action of water at a high temperature and pressure, amounted to ten million, three hundred and thirty-seven thousand, one hundred and forty-seven pounds, (10,337,147 lbs).

11. That the profits made by defendant by his use of complainant's process, amounted to the principal sum of one hundred and sixty thousand, six hundred and ninety-nine $\frac{05}{100}$ dollars, ($160,699 05), being the value of the following articles saved, at their market price when saved, viz:

Lime saved,	1,552,889 lbs.	Value,	$11,243 26
Sulphuric Acid saved,	3,105,778 "	"	100,663 51
Fat saved,	230,057 "	"	28,118 01
Profit on Glycerine obtained from	10,337,147 lbs.		
of fat, $\frac{1}{2}$ cent per lb. fat, ...			20,674 27
			$160,699 05

together with interest on said sums from the dates when the saving was realized, as set forth in the calculation appended to the printed argument submitted by the counsel for complainant."

The plaintiff contends, that the defendant, by manufacturing fat acids and glycerine from fatty bodies, by the action of water at a high temperature and pressure, according to the plaintiff's process, has saved the quantities specified, of lime, sulphuric acid and fat, in working the specified quantities of fat, aud has made the specified additional profit from the specified quantity of glycerine; that such saving and profit are due to the use of the plaintiff's process; and that the defendant must account for the same, as profits, under the interlocutory decree. The defendant contends, that he has made no gains or profits by the use of the plaintiff's invention; that such invention is incapable of practical use; and, that whatever saving the defendant has made by working the process which he uses, is due to something other than any invention of the plaintiff's.

The defendant formerly used, in his manufactory, what was known as the lime saponification process. Twenty-five pounds of water and one hundred pounds of fat were put into a vat. From nine to fourteen pounds of lime were slacked in another vat with sixty-six pounds of

water, and the product was then gradually poured into the fat and water, which were boiling, and the whole was kept boiling for about eight hours. It was then allowed to stand and cool, and the water was drawn off, carrying in it the glycerine. The residue, called lime soap, was then decomposed by sulphuric acid, and produced free fat acids. The defendant, since abandoning this old process, has worked under and according to letters patent of the United States, granted to Robert Alfred Wright and Louis Jules Fouché, January 25th, 1859, for "improvements in process for decomposing fats." All the fat he has treated has been treated according to the process and by the apparatus described in that patent. The specification of that patent states, that the apparatus which it describes is chiefly intended for the decomposition of fatty substances into fatty acids and glycerine. A detailed description of the apparatus and of its action is given. There are two boilers. The lower boiler or first boiler, is completely filled with water. The upper boiler or second boiler is filled with water up to one-third of its height, and then filled up to a certain point with the fatty bodies to be decomposed. The first boiler, which is strong enough to resist a pressure of from ten to twenty atmospheres, is gradually heated till the proper pressure, according to the nature of the fatty matter, is attained. The superheated water in the first boiler ascends through a tube which runs from the top of the first boiler into the upper part of the second boiler and there terminates in a rose jet, discharging downwards. The water, passing through the holes in the rose jet, descends through the fatty matter, and passes out of the bottom of the second boiler, through

a tube, which enters the top of the first boiler, and passes through its interior to near its bottom, and there discharges into it. The mixture of fatty matter and water, carried down by the passage from the second boiler to the first boiler, is again heated, to recommence its ascending motion, and so on. A continuance of this operation during a period of from five to eight hours, according to the nature of the fatty bodies operated on, and according to the variation of pressure, varying from ten to twenty atmospheres, decomposes the fatty bodies into glycerine and fatty acids, the glycerine remaining dissolved in the water and the fatty acids floating in the second boiler. The patentees say, in their specification: "We are aware that, firstly, the decomposition of fatty bodies by water, under the influence of heat and of pressure, is a well known scientific fact. Water is substituted for the organic basis; it forms a perfect and fixed combination with the fatty acids, while the glycerine is dissolved in the excess of water. Secondly, that, as this chemical action takes place under the influence of a weak affinity, it is necessary, in addition to the above named physical and chemical conditions, to insure a perfect molecular agitation of the whole mass, and that we wish it to be understood, that what we wish to claim and establish as of our invention, consists of an apparatus wherein the water and the fatty matters are heated separately in two different boilers. The first boiler is heated by the source of heat, while the second boiler is heated by the first boiler. In these boilers, the agitation necessary for the chemical action and combination is produced by the pressure of the heated water in the first boiler. This water

circulates continuously from the first boiler to the second boiler, and from the second boiler to the first, in a continuous and self acting or automatic manner, without interruption. The characteristics of our apparatus are, that it produces agitation by circulation alone, a continuous and automatic circulation, produced by the pressure of water. Lastly, our apparatus effects its chemical action in a continuous manner, without the aid of any manual or other assistance." The claim of the Wright and Fouché patent is as follows: "Having described the nature of our invention, and the manner in which the same is to be performed, we do not claim the application of superheated water for decomposing fatty bodies, nor the form of the apparatus above described, which may vary somewhat according to conditions and circumstances; but what we claim as our invention is—producing a continuous automatic circulation of highly heated water, in a very finely divided state, through the bodies under treatment, by means of an apparatus constructed and employed substantially as herein shown and described."

It is manifest, that, in using the Wright and Fouché apparatus, the defendant decomposes fatty bodies into fat acids and glycerine by the action of water at a high temperature and pressure, and thus uses the plaintiff's process. But, the defendant urges, that he works at a lower temperature than that designated by the plaintiff, and takes more time for the operation, and employs a continued agitation or circulation of the fat, water and steam; and that those are features not described in the plaintiff's patent, and features to which all the profits made by the defendant are entirely due. Stress is par-

ticularly laid on the fact that, without the use of means to produce agitation and circulation of the fat, water and steam, the employment of heat and pressure would result in no pecuniary profit. The other points urged are disposed of by the opinion of Mr. Justice Nelson.

It is a mistake to contend that the plaintiff does not, in his specification, enforce the necessity of keeping up an intimate mechanical mixture of the fat and water during the operation. He directs that the fat and water shall be mixed, and he calls, in many places, the liquid that is being operated upon, a mixture. His description and drawing of the coil apparatus state and show, that a disc or piston, perforated with numerous small holes, is kept in rapid motion up and down in the vessel into which the fat and water are first put, to cause them "to form an emulsion or intimate mechanical mixture." He also states, in reference to the coil apparatus, that "it is important for the quickness and perfection of the decomposition, that the oil and water, during their entire passage through the heating tubes, should remain in the same state of intimate mixture in which they enter them;" and he suggests two devices for maintaining such thorough mixture. It is impossible to maintain the proposition that the plaintiff's specification ought not to be construed as fully disclosing the desirableness of keeping the fat and water intimately mixed during the operation, with a view to effecting a speedy and complete decomposition, as well when the "convenient vessel" first named is used, as when the coil apparatus is used. The evidence is, that the decomposition will take place without mixture, in a

time proportioned to the degree of heat and the extent of the area of surface contact between the fat and the water. Having indicated the propriety of using means to maintain an intimate mixture of the fat and water, the plaintiff is entitled to use, in carrying out his process, any means then known and used in the same art for maintaining a mixture of fat and water. In the lime saponification process, the stirring or agitation of the fat, water and lime during the process, in order to keep up an intimate contact between the particles, was employed; and the proofs show the description or use, before the date of the plaintiff's patent, of a vertical churn agitator to mix fat, water and lime, while being boiled in an upright boiler under pressure, of a rotary paddle wheel agitator to mix fat, water and lime, while being boiled in a horizontal boiler under pressure, and of a stirrer rotating on a vertical shaft, to mix fat, water and lime, while being boiled in an open tub. The plaintiff's specification is addressed to persons skilled in the department of manufacturing to which it is applicable; and the evidence is abundant to show, that such persons would have understood, as a matter of course, that, with a view to practical and profitable manufacturing, there must be agitation of the mass, and would have readily used known devices at hand to produce such agitation.

The defendant has entirely failed to show that the plaintiff's process, carried out as described in his patent, is not practicable or practical. It was put in practical operation in London in 1857, a patent having been taken out for it in England by the plaintiff, January 9th, 1854. It was put in operation in Cincinnati, Ohio,

in 1860, and has been in use, under license from the plaintiff, in the United States, ever since, there being ten factories in the United States working under such license. The defendant was notified by the plaintiff in September, 1860, not to infringe the patent, and what he has done has been done wilfully and not innocently.

It is abundantly shown, that the saving of lime and sulphuric acid and fat, and the increased profit from the glycerine produced, result from the use of the plaintiff's process, and not from the special apparatus of Wright and Fouché. Such apparatus is one means of producing stirring or agitation and mixture. The plaintiff's process, when carried on with other means of maintaining the mixture, produces, as is shown by the evidence, the same saving of lime and sulphuric acid, which is produced by the defendant in using the Wright and Fouché apparatus; and such apparatus is useless, unless a high heat and pressure be employed. The defendant previously used the lime saponification process, and abandoned it for the plaintiff's process. He must be regarded as having made, directly, by using the plaintiff's process, the saving of lime, sulphuric acid and fat, and the profit in respect of glycerine, which existed between the use of the two processes, and which saving and profit he would not have made if he had continued to use the old process. He has not made the saving by using the Wright and Fouché mixing apparatus. Ropes used the heat and pressure with a paddle wheel mixer, and made the saving of lime and sulphuric acid. Jones used a pump to mix, with heat and pressure, and made the same saving.

The use of superheated water is the effective decomposing agent in the defendant's process. If the use by the defendant of the Wright and Fouché mixing apparatus saves labor or fuel, as compared with any prior process, the plaintiff is not entitled to the saving thus effected. But, the defendant has not shown any such saving of labor or fuel. The proof as to the saving of lime, sulphuric acid and fat, and as to the increased profit on the glycerine produced, at the quantities and values set forth in the plaintiff's exceptions, is full and clear.

On the hearing, the defendant's counsel did not dispute, that, if the saving of the lime, sulphuric acid and fat was due to the use of the plaintiff's process, the plaintiff was entitled to the value of such saving, as profits. That is undoubtedly a correct principle, as applicable to an accounting for profits, in a case of this description, in equity.

The plaintiff's exceptions, above set forth, must be allowed. But, as the calculations based on the evidence taken before the Master, and furnished by the plaintiff, show just how much the plaintiff is entitled to recover, it is unnecessary to send the case back to the Master. The account was taken down to the expiration of the patent, on the 9th of January, 1868. The savings are calculated at 13½ pounds of lime, 27 pounds of sulphuric acid and 2 pounds of fat, on each 100 pounds of fat worked. This, at the prices shown by the evidence, makes the saving in the aggregate, of lime, sulphuric acid and fat, $140,024,78. The increased profit on glycerine, at one-fifth of a cent per pound on the quantity of fat worked, was $20,674,27. The saving of lime,

sulphuric acid and fat is calculated from and including the 1st of July in each year, to and including the 30th of June in the following year, covering the period from and including December, 1860, to and including January 9th, 1868. The increased profit on the glycerine is calculated from and including the 1st of January in each year, to and including the 31st of December in the same year, but only covers the fat worked from and including July 1st, 1861, to and including January 9th, 1868. I think that the plaintiff is entitled to interest from and after the close of each of such years, on the ascertained value of the savings and profits for the twelve months next preceding. Making up the account on these principles, gives the following results:

SAVINGS OF LIME, SULPHURIC ACID AND FAT.

For the year ending	Quantity of Fat Worked.	Value of lime, Sulphuric Acid and Fat saved.	Interest to September 1st, 1871.		
			Years.	Per Cent.	
June 30th, 1861..	1,165,745 lbs.	$ 8,996 86	10⅛	71⅛	$6,402 77
" " 1862..	1,502,316 "	11,063 28	9⅛	64⅛	7,098 94
" " 1863..	1,050,426 "	8,718 84	8⅛	57⅛	4,984 27
" " 1864..	1,395,142 "	14,556 26	7⅛	50⅛	7,302 39
" " 1865..	1,993,051 "	33,993 58	6⅛	43⅛	14,673 90
" " 1866..	1,613,263 "	26,254 43	5⅛	36⅛	9,495 35
" " 1867..	2,001,162 "	28,344 58	4⅛	29⅛	8,267 17
To Jan'y 9, 1868..	781,787 "	8,096 95	3 3/365	25 17/365	2,062 47
	11,502,892 lbs.	$140,024 78			$60,287 26

INCREASED PROFIT FROM GLYCERINE SOLD.

For the year ending	Amount received for Glycerine sold.	Quantity of Fat Worked.	Profit at $\frac{1}{2}$ of a cent per lb. of fat worked.	Interest to September 1st, 1871.		
				Years.	Per Cent,	
Dec. 31st, 1862..	$6,048 32	1,502,316 lbs.	$ 3,004 63	$8\frac{2}{3}$	$60\frac{2}{3}$	$1,822 81
" " 1863..	7,543 97	1,050,426 "	2,100 85	$7\frac{2}{3}$	$53\frac{2}{3}$	1,127 46
" " 1864..	16,330 16	1,395,142 "	2,790 28	$6\frac{2}{3}$	$46\frac{2}{3}$	1,302 13
" " 1865..	15,273 70	1,993,051 "	3,986 10	$5\frac{2}{3}$	$39\frac{2}{3}$	1,581 15
" " 1866..	17,804 88	1,613,263 "	3,226 52	$4\frac{2}{3}$	$32\frac{2}{3}$	1,054 00
To Jan'y 9, 1868..	35,777 94	2,782,949 "	5,565 89	$3\frac{233}{356}$	$25\frac{117}{356}$	1,417 76
	$98,774 47	10,337,147 lbs.	$20,674 27			$8,305 31

This makes the total amount for which the plaintiff will be entitled to a decree, September 1st, 1871, $229,291 62. Let a decree be entered, of that date, for that amount, with costs.

GEORGE HARDING, for the Plaintiff.

CHARLES M. KELLER, and STEPHEN D. LAW, for the Defendant.

Supreme Court of the United States.

No. 883.

RICHARD A. TILGHMAN, APPELLANT,

VS.

WILLIAM PROCTER, JAMES GAMBLE, W. A. PROCTER, JAMES N. GAMBLE AND GEORGE H. PROCTER.

No. 895.

WILLIAM PROCTER, JAMES GAMBLE, W. A. PROCTER, JAMES N. GAMBLE AND GEORGE H. PROCTER,

APPELLANTS,

VS.

RICHARD H. TILGHMAN.

BRIEF FOR DEFENDANTS.

STATEMENT.

This is the suit in which this Court, by the Opinion reported in 102 U. S. 707, reversed the interlocutory decree in favor of defendants, which had been entered in pursuance of its judgment in *Mitchell against Tilghman*, 19 Wall. 287. It now comes up on cross-appeals from a decree of the Circuit Court for the Southern District of Ohio, affirming the Master's report, and awarding damages to the amount of Eighty-three Thousand Two Hundred and Seventy-five 21-100 Dollars ($83,175.21) for infringement of the Tilghman patent, No. 11,766, dated January 9, 1856, for "Improved mode of treating fatty and oily bodies."

The infringement for which this judgment was rendered consisted in the use, in the defendants' factory, for about four years and eight months, of apparatus which this Court, when the case was last before it, held to infringe this patent. The Master computed these damages on the basis of an established royalty, adding interest from the end of each month. This royalty has only been paid for the use of the patented invention, coupled with subsequent improvements. The only royalty shown to have been exacted for it before these improvements were introduced was about one-tenth that taken as the basis of computation. A large proportion of the interest allowed is for the period between the decision in this Court, in *Mitchell against Tilghman* (which held the patent either invalid or limited to apparatus and conditions which these defendants did not use), and the reversal of that decision by its Opinion in this case.

The Master also reported defendants' profits at one hundred and twenty-nine thousand four hundred and forty-one dollars and forty-seven cents ($129,441.47), assuming in this computation that, as the Court had held the patent to cover the process worked by "any convenient vessel," complainant was entitled to all the profits obtainable by the improved mechanism of defendants, and not limited (as contended by defendants) to such profits as could be made either by the apparatus described in the patent as the best known to the patentee, or by such other "convenient vessel" as was available at the date of the patent, and capable of use under the conditions prescribed by it. The Master conceded that advantages due to the use of lime as an agent in the saponification, and to successive charges of water, were not to be credited to complainant, but refused to apply the same rule to those advantages due to improvements in the apparatus, apparently understanding that, when the Court held that defendants did not escape infringement by substituting for the simple "convenient vessel" suggested by the patent an apparatus which superadded to the office of a vessel

vital functions of its own, this was equivalent to holding that complainant was entitled to all advantages obtainable by such improvements or modifications of the "convenient vessel."

Both parties excepted to the Master's report. Defendant's exceptions are on page 1563, transcript.

The Court entered judgment on the basis of the damages reported by the Master, and did not allow his estimate of profits. The claim under which this accounting arises is

"the manufacture of fat acids and glycerine from fatty bodies by the action of water at a high temperature and pressure."

This separation of fat bodies into fat acids and glycerine, which compose them, is one step in the process of soap and candle making. The patentee does not claim to be the first to effect this separation. He recognizes in his patent the fact that it had long before been one of the incidents of candle making. He states in his specification that

"the fat acids thus produced may, like those obtained by other methods, be used in the manufacture of candles and soap, and applied to various purposes, according to their quality, and when desired they may also be first bleached by chemical agents, or purified by distillation in a current of steam or in a vacuum, as is now well understood."

Also, that the solution of glycerine obtained may be "concentrated and purified by the usual means."

One of the common modes of effecting this separation prior to the time of Tilghman was by boiling the fat in water with a mixture of lime, either in closed tanks under pressure or in open tanks (*Ex. Roret, p.* 539; *Ex. No.* 18, *p.* 296).

The theoretical equivalent of 100 pounds of fat is about 9½ pounds of lime (*Dep. Morton, p.* 1374, *a.* 33; *Dep. Endemann, p.* 1264, *a.* 78.) In practice from 11 to 14 pounds of fat were commonly used when the operation

was carried on in open tanks (*Dep. N. Ropes, Jr.*, *p.* 144, *a.* 2; *Dep. Spies*, *p.* 588, *a.* 3; *Dep. Wiedemer*, *p.* 589, *a.* 3; *Dep. Grant*, *p.* 1057, *a.* 7).

The advantage of closed tank with pressure over the open tank had been pointed out in printed publications, and "an important diminution in the proportion of lime" mentioned as likely to be obtained by an increased temperature and pressure (*Ex. Roret*, *p.* 539; *Ex. No.* 18, *p.* 296).

The improvement which the Court has held to be secured in the Tilghman patent consists in applying such degree of heat and pressure as to dispense with the use of lime, making water and heat the agents in effecting such a separation.

The patent describes what it represents to be the best mode of working the invention, consisting of a coil of pipe in a solid body of cast iron, through which pipe the mixture of fat and water is pumped, the heat which effects the separation being applied by radiation through this casting and pipe from the furnace immediately beneath. The melting point of lead (612° F.) is mentioned as at that at which good results can be obtained, with the statement that the heat can be carried considerably higher with advantage, and that with some kinds of fat, such as palm oil (which is disintegrated more rapidly than most fats, and is not involved in this controversy), the decomposition takes place at or below the melting point of bismuth (510° F.).

It states that the pipes used for this purpose should be tested to a pressure of ten thousand pounds to the square inch, though the patentee says he believes the working pressure necessary in using the heat he has mentioned will not exceed two thousand pounds to the inch. He states that instead of using this coil apparatus "the mixture may be placed in any convenient vessel in which it can be heated to the melting point of lead." There is no suggestion of any mode of applying the requisite heat, other than by externally heating the vessel, as is done in the

coil apparatus. The caution against allowing any steam within the containing tube or vessel (several times repeated in the specification) shows that no other mode of heating was contemplated or supposed to be practicable. The high pressure prescribed would also practically have excluded the introduction of steam within the receptacle, since any pressure therein would necessarily be communicated to the boilers and all connecting mechanism. The enormous thickness of metal required in any tank of large dimensions for resisting the prescribed pressure; the difficulty of applying through such walls the intense heat required, so as to secure uniformity of temperature throughout the interior; the danger of scorching portions while not sufficiently heating other portions; the necessity for perfect uniformity of exposure in all parts of the bulk of fat; the liability of the metal walls to crack under the heat applied; and the danger incident to an explosion of the tank under such pressure, would combine to preclude its use for practical purposes; and neither the patentee nor any one else appears to have ever undertaken to use such a "convenient vessel" on a working scale. The coil apparatus, which the patentee was undoubtedly correct in pointing out as the best mode then known of practicing the invention, while it has been shown to the satisfaction of the Supreme Court to be capable of operation, so far as to prevent the patent from being held invalid as being for an inoperative device or process, has never been put into practical use, either during the life of the patent or during the eight years since its expiration.

Defendants' mode of effecting the saponification, which has been held to infringe complainant's patent, is illustrated in the drawing on page 84½ M. Rec. Exhibits. There is a digester, having within it a shell, a space being left between this shell and the outer walls of the digester. Within this shell and near the top, is a perforated diaphragm extending across the shell. A pump is placed within the shell, its piston rod extending vertically through it and communicating with external motive power. A

pipe leads from the piston chamber, which is at the bottom of the digester, to a point within the shell above the perforated diaphragm, and the digester is connected by a pipe to a steam boiler. The fat and water are placed in this inner shell and mixed with lime in the ratio of about one pound to one hundred of fat. A supply of steam from the boiler is then introduced within the digester, so that it envelopes the inner shell, occupying the space between it and the outer walls, and also enters the inner shell and comes in direct contact with the mixture of fat, water, and lime. This steam is, through its connection with the boiler, maintained throughout the operation (9 or 10 hours) at a heat sufficient to give from 200 to 250 pounds of pressure to the inch. The pump being kept in constant motion, draws the water from beneath the fat and carries it above the perforated diaphragm, where it passes through the steam and is replenished in heat, then, being filtered in fine jets by the diaphragm, is passed back through the fat, which, by reason of its lesser consistency, tends to rise to the surface of the water, while the force applied by the suction of the pump forces the water through it. The water saturated with lime, is thus driven in a continuous counter-current through the fat, the water passing through the steam and through the perforated diaphragm before each successive encounter with the fat. After the operation is partly completed, the water with its load of glycerine is drawn off, and a fresh charge of water substituted, and the operation repeated.

This forcing of the water and fat through each other in counter-currents, and the use of the successive charges of water, are both the subject of a subsequent patent in behalf of the same patentee, not involved in this suit. Other features of the process and apparatus are taken from patents to strangers subsequent to that here sued upon, as more particularly pointed out hereafter.

It is established beyond controversy, and conceded in the Master's report, that all attempts to operate the process for practical purposes, either with the coil apparatus

exhibited in the patent or with any other convenient vessel known at the time, were abandoned after repeated and extensive trials by various manufacturers in different countries, some of whom had extraordinary inducements to use it if it possessed economical advantages over older processes. It was many years after the date of the patent after these efforts had been made, some of them at great expense, and had been abandoned, after the patentee himself had patented later improvements, and after both process and apparatus had been radically altered as well as supplemented by new agencies, all developed by subsequent invention, that it became able to compete in the market with older processes. Since this it has only been able to maintain such competition, while manufacturers to whom it, with subsequent improvements, has been open (upon royalty during the term of the patent and without royalty or restriction of any kind during the eight or nine years that have elapsed since the expiration of the patent, and before the accounting), have continued to use older processes in preference to it.

Complainant has never manufactured by this process, either modified or unmodified. The only mode of realizing profit under it ever adopted by him has been by granting general licenses at a fixed rate of royalty to all manufacturers that were willing to take them. The royalty fixed by the patentee upon the invention in its original shape, before the addition of subsequent improvements, was five thousand francs for the first two and one-half million kilograms (5,512,500 lbs.) per year (less than two cents per hundred weight), and five francs per thousand kilograms for all in excess of this amount. This included the exclusive right to the process and to all subsequent improvements, giving the grantee a complete monopoly (Moinier contract, p. 370–372). After the introduction of subsequent improvements, including those patented by him in May, 1860, complainant fixed the royalty at twenty cents for each one hundred pounds of fat where no lime was used, and half this where seven

pounds of lime per hundred weight was used. In no instance has this royalty been paid for the use of the invention in its original form, apart from later improvements.

It appears from complainant's evidence before the Master that complainant had, during the entire term of infringement, only a fractional interest in the patent and in the royalties, profits and recoveries to be had thereunder, and that the remainder of the title and interest was in a stranger to the suit. Complainant has not shown what his fractional interest was.

Complainant is asking for an award of profits several times as large as that reported by the Master, and on a basis of estimated savings, which defendants insist to be purely speculative and no part of which any manufacturer has ever been able te realize in practical operation.

ASSIGNMENT OF ERROR.

It is insisted that the Court below erred:

First. In awarding complainant a recovery of royalties of twenty cents per hundred, together with interest theron, or any part thereof.

Second. In overruling defendants' exceptions to the Master's report, and each of them.

MEASURE OF RECOVERY.

It is submitted on behalf of defendants:

First. That if profits are to be computed on the basis of the difference in cost of production between the patented process and older ones they must be limited to those profits affirmatively shown to be capable of being realized by the use of the process in the manner exhibited in lhe patent, in excess of those attainable by older processes, and can not include those only made possible by subsequent modifications; and that the evidence shows that the process as originally exhibited, could not, with the aid of all the knowledge and skill possessed by the patentee, or by the foremost men in the art, and with any convenient vessel then available, be operated on a manufacturing scale with any profit over old methods.

The evidence on this point is cited and in part collated under the title, "Practical Economy of Complainant's Process," *post*. It does not depend upon expert opinions obtained for the purpose of evidence. It comes from the invariable experience of every manufacturer who undertook to use the process, from Moinier and Tilghman himself down to the Emerys, the latter since the patent was thrown open to the public. All these efforts were made under circumstances that made it strongly for the interest of the manufacturers to obtain the best practical results, and all, except that of the Emerys and Janssen, with the benefit of Tilghman's aid, both in selecting apparatus and working it. They, without exception, show that, with the use of the apparatus described in the patent, or any other "convenient vessel" known at the time, neither the patentee nor the best informed manufacturers or experts in the art could obtain such results as would enable this process to compete profitable with the older processes. It is difficult to conceive of evidence more conclusive and overwhelming than that thus derived.

Manufacturers may differ in their choice of processes clearly approximating each other in economy, but where there is a pronounced and substantial difference in economy between processes placed at their disposal they do not adopt or continue that which involves decided loss, or refuse to avail themselves of improvements capable of effecting material savings.

The scientific tests which have been made since litigation arose over this patent confirm the evidence drawn from the efforts at practical working, and show how each of the various modifications subsequently introduced have contributed to give to the process whatever economical value it may possess.

Complainant lays stress upon the patent not being confined to the apparatus shown in it, and there pointed out to be the best known to him, and insists that a comparison of the results obtained by that apparatus and by old processes, is unfair to him. It would seem to be a

very liberal rule of profits that gave him all obtainable by what his patent pointed out as the best mode known to him. But, certainly he can not claim a larger measure of profits until he has shown that a larger profit was attainable by his process through some other "convenient vessel" known to the art at the time. This he has not undertaken to show. On the contrary, the history of the efforts made to utilize the process proves affirmatively that it was not possible to work it economically with any "convenient vessel" then known to the art, or that either Tilghman or other manufacturers were at that time able to contrive.

No vessel, other than the coil apparatus, which could apply on a working scale the heat required by the patent, with sufficient uniformity throughout the body of fat, without the introduction of steam (which was excluded by the terms of the patent, and was besides impracticable under the high pressure there called for), has ever yet been contrived.

Though the improvements and modification subsequently introduced have been held not to relieve defendants from infringement, the profits made possible through those modifications do not accrue to the complainant. *See title "Practical Economy of Complainant's Process," post.*

Second. That where, as in the present instance, complainant's only mode of enjoying his franchise has been by licensing its use at a fixed royalty, and where the withholding of this royalty is the only loss the complainant has suffered by reason of infringement, and the only profit defendants realized by using the invention unlawfully, instead of upon the terms at which the patentee had placed it at the disposal of the public generally; where the infringer does not enter into the profits of a close monopoly, but only uses what every one is at liberty to use at the prescribed terms, and what it is the policy and interest of the complainant to have him use on such terms; the relative cost of production by the old and new process affords no measure of actual profits realized by defendants or withheld from complainant, and the royalty is the limit of complainant's

recovery, embracing as well all the profits which should equitably accrue to complainant, as all the damages sustained by reason of the trespass.

The only profits withheld in such a case are the fixed tolls or rent charges which the patentee has adopted as the mode of realizing on his property. Modes of computing profits applicable to cases where the franchise has been exercised as a close monopoly, would be speculative and misleading here. The inevitable effect of thus putting the franchise upon the market is to throw the different manufacturers into the same competition that would exist where there was no patent, thus readjusting prices to correspond to any reduction in the cost of production, and giving the several manufacturers, in addition to the royalty or toll exacted, only ordinary manufacturers' profits.

Suppose, for instance, that the cost of manufacturing glycerine by the old process, was one dollar a pound, and a new process was invented by which it could be produced at a cost of twenty-five cents per pound. If the patentee of the new process retained the exclusive right to manufacture, he would only have to compete with those who manufactured at the cost of one dollar a pound, and could sell at the same rate, thus saving the difference in cost of manufacturing. By taking this course he would obtain a very large profit per pound on all he sold, and the infringer who appropriated a share in such monopoly, might make the same profit per pound. But, while this policy would give the patentee seventy-five cents a pound profit, over ordinary manufacturers' profit, it would give him that profit only on the comparatively small number of pounds which he could sell at the high price at which those who still pursued the old method were selling. There would be no tendency to increase his number of sales, or to give him any advantage in the market over rival manufacturers. If, before the adoption of his new process, he was selling five per cent of the glycerine used in the country, there would be no tendency to increase that proportion, and he would receive no tribute from the other ninety-five per cent.

If, on the other hand, the patentee adopts the policy of putting the right to use his process on the market at a moderate royalty, that is, for some fractional part of the actual saving per pound, he obtains that smaller rate per pound on that manufactured by all the factories which use it, and if he makes the rates sufficiently moderate, he obtains that profit per pound, not simply on the quantity that has hitherto been manufactured by others as well as that manufactured by himself, but the reduction in selling price, which naturally follows the placing of the process in competition among the various factories, as distinguished from holding it as a close monopoly, would tend to multiply the quantity of glycerine used, making it available for many purposes which, at a higher price, it was not available for, and leading to lavish use where before it had been but sparingly used. The smaller the royalty, the more it tends to increase the sale and thus multiply the number of pounds upon which the royalty accrues.

Suppose the royalty, in the case assumed, fixed at ten cents per pound and that the competition between the various manufacturers, all licensed at that low rate of royalty, has reduced the selling price of glycerine to one-quarter its former price, and thereby multiplied ten-fold the quantity sold. The patentee is obtaining but ten cents per pound, but he is obtaining that ten cents two hundred times where he would have obtained the seventy-five cents once, besides avoiding the investment of capital and labor necessary to carry on the manufacture himself, and the hazards incident to such manufacture. The manufacturers, on the other hand, have no exclusive rights, and have no part in a monopoly. They are subject to the same competition as before, and make in addition to their royalty only ordinary manufacturers' profit. Their profit per pound instead of being increased will almost inevitably be decreased, as the ratio between the cost of production and the profit per pound will remain approximately the same. If the profit has usually been twenty-five per cent. of the

cost, it would be twenty-five cents when the cost was one dollar, and six or seven cents when the cost was twenty-five cents per pound. A fair illustration of this is found in the testimony of complainant's witness, Shoemaker, who says that in 1846 he made glycerine at an estimated cost of two dollars a pound, and sold it at four dollars, making a profit of two dollars a pound. He has since bought glycerine at fourteen cents per pound. The reduction in the cost of manufacture certainly did not tend to increase the profit per pound, but the reverse. It would be absurd to say that the manufacturer who was selling at fourteen cents a pound was making two dollars a pound more profit than the one who was manufacturing under the old conditions (*Dep. Shoemaker, p.* 1236, *a.* 3-7; *p.* 1239, *X. Q.* 30-34.)

The infringer, instead of trespassing on a monopoly and sharing the profits of that monopoly, at the rate which might be maintained if all competition was excluded, only avails himself of what is open to the public at a fixed toll, and derives no profit from his trespass beyond the withholding of the toll which others are paying.

Now, if, in a case where the policy of the patentee had been to put his process at the disposal of manufacturers generally at a fixed toll, and thus multiply the number of pounds that pay toll by the conditions of competition that are secured by this policy, we are to estimate the profit of an infringer by multiplying the number of pounds he has sold under these conditions by the rate of profit the patentee would have made if he had retained a close monopoly, we are taking the exorbitant multiplicand which belongs to one policy and applying to it the manifold multiplier which is only possible through the other policy, and obtaining a purely fictitious product, enormously out of proportion to any actual profit that has been made, or could possible be made by either patentee or infringer under either policy.

Recurring to the mathematical ratio before taken for illustration, while the relative profits to be made by each

of the two, policies will be represented by 75 multiplied by 5, and 10 multiplied by 200, respectively, the computation applied to infringers would be 75 by 200. This would be an ingenious method of computing penalties, but, as a mode of equitable relief, is mere jugglery.

The profit obtained by the patentee where the franchise is farmed out on royalty is dependent on the fact that the cost to consumers is so reduced as to multiply the amount consumed, and the benefit of that reduction accrues to the public. The Master is in error in assuming that there is no evidence of such reduction, and equally in error in assuming that it was necessary for defendants to offer such evidence. The testimony of complainant's witness, Shoemaker, above cited, is most significant evidence of the fact. Tilghman, in his application for extension, represented the reduction in cost to be so much "realized to the community," and "saving to the country" (p. 1108). His witness, Rogers, states that since the introduction of his invention the supply of glycerine in large quantities and at a comparatively low price has increased its consumption a hundred-fold. (p. 1118.)

But evidence on this point was unnecessary, for the moment the policy of placing at the disposal of the public generally, at a uniform royalty, is adopted, the reduction in cost of manufacture effected by the process ceases to afford any indication of the profit per pound which either patentee, licensee or infringer realizes from the process. The profits, outside of that royalty or rent-charge, depend, as in case of any unpatented process, upon purely commercial considerations.

The fictitious mode of estimating profits contended for by complainant would usually give, as the profit for a brief period on a single step in a complex manufacture, more than the accumulation of a lifetime in the entire manufacture, to which many other inventions, many unpatented machines and processes, extensive business skill, enterprise, good-will, and capital, had all contributed. The general application of such a rule would make manu-

facturing impossible, because of the illimitable hazards it would carry with it.

Manufacturers are liable to find themselves held as infringers where they have taken every precaution to avoid trespassing on the rights of others. What they suppose they have the right to use, and what the best counsel they can consult advise them they have the right to use, they sometimes find the courts hold to be an infringement. The courts themselves take at different times, with equal confidence, opposite views of the same question of infringement. There is no class of rights where there is more room for honest difference of opinion. It would not be easy to contrive a more effectual means of suppressing all enterprise and progressiveness in manufacturing, than by administering crushing penalties for every overstepping of the indefinite and indeterminate lines by which most such franchises are bounded. It is not to the inventor alone, but to his work supplemented by the practical and enterprising manufacturer, that we owe the introduction to the public of substantial improvements in the arts. The work of the inventor would usually be unprofitable to himself and unavailable to the public if that work were not taken up and carried on by manufacturers who have special facilities, or special skill, in their respective departments. If the measure of recovery administered in these cases is to be in excess of what is necessary to fairly compensate the patentee, and multiplied upon the speculative basis here contended for, the law would not only be made unjustly oppresive and destructive to the manufacturing interest, but would defeat its own ends by deterring manufacturers from introducing any modification or improvement in their art, because of the danger they incur of unforeseen constructions of apparently abortive or dormant inventions, bringing upon them excessive judgments that more than wipe out all their investment, all the proceeds of their industry, and all their other possessions, wrecking at once all accumulations of the past and all prospects for the future.

The deposition of Jas. N. Gamble illustrates the number of machines, processes and commercial conditions among which the credit for profits in the manufacture of candles and glycerine must be divided, many of the implements and processes being such as may individually claim profits on the same speculative basis as the Tilghman (p. 1345 a. 35).

In *Tilghman* v. *Mitchell* (9 Blatch., p. 1), the Court had not before it the same case of infringement, or one in which so many modifying agencies entered into the work of defendants, as in the present instance, or the evidence by which the agency of these modifications in effecting the result is shown in the present cause. The question of the effect of established royalties for general use of the invention, in fixing the measure of recovery, was excluded from consideration. The Court, says, distinctly, in its opinion, that

"Defendant's counsel did not dispute that, if the saving of the lime, sulphuric acid and fat, was due to the use of the plaintiff's process, the plaintiff was entitled to the value of such saving or profits." (p. 16.)

Defendant's counsel, in that case, evidently chose to withhold the evidence as to established royalties, on the theory that, by so doing, they would avoid affording the basis for any recovery at all.

The question here presented is quite distinct from that in the *Cawood cases* (94 U. S., p. 695). The Court there held simply that profits accruing to defendants by reason of the use of complainant's invention, are not to be withheld because in other and independent parts of their business defendants have made a loss. The profits in that case were such as accrued to and remained with the defendants, being profit obtained by the use of the invention in repairing their own property. It was a case where the saving necessarily accrued to and was realized by the infringer, as distinguished from the case where it was a saving tending to reduce the cost of the article on sale in

competition with others. It is to be observed, also, in connection with this case, that the Court comments upon the deficiency of the record in the matter of the account, and explains that it is picking out of it a basis of recovery in order to bring to a close protracted litigation. There was no showing of established royalty, or other basis upon which recovery could be had. After referring to this case in *Root* v. *Railroad Company*, 105 U. S., p. 189, the Court takes care to point out that the rule which gives profits in equity was formulated

"Out of tenderness to defendants, in order to mitigate the severity of the punishment to which they might be subjected in an action at law for damages, and because it was thought more equitable merely to deprive them of the actual profits arising from their wrong, than to make no allowances. in estimating damages, for the cost and expense of the business in the prosecution of which they had violated the rights of the complainant." (p. 215.)

And points out that

"The jurisdiction of equity is adequate to give the proper remedy, whatever phase the case may assume." (p. 197.)

This rule is summarized in 1st Story, Eq. Jur., section 28, as follows:

"But courts of equity are not so restrained; although they have prescribed forms of proceeding, the latter are flexible, and may be suited to the different postures of cases. They may adjust their decrees, so as to meet most, if not all, of these exigencies; and they may vary, qualify, restrain and model the remedy, so as to suit it to mutual and adverse claims, controlling equities and the real and substantial rights of the parties." . . . . "So that one of the most striking and distinctive features of courts of equity is, that they can adapt their decrees to all the varieties of circumstances which may arise, and adjust them to all the peculiar rights of all the parties in interest." See Sanders v. Logan, 2 Fish. 167 (170). Packet Co. v. Sickles, 19 Wal. 611 (617).

Third. That where there is a definitely ascertainable measure of compensation that will do complete justice to both parties, on the basis of royalty, and the profits are indefinite and speculative in amount, the former rather than the latter should be adopted as the measure of recovery.

Profits are adopted as the measure of recovery in equity, not as an arbitrary and inflexible rule to be administered without reference to the circumstances of the case, but rather as usually affording a mode of putting each party in the exact position he would have occupied if no trespass had been committed. If, for any reason, this basis of estimating the recovery would fail to serve that purpose, and there is at hand some other measure that precisely accomplishes that purpose, the ground for its adoption ceases to exist, and it has no application. It is subordinate to the primary rule of equitable relief, which is to apply such remedy as, under all the circumstances of the case, shall most exactly serve to restore both parties to the status they would have occupied if the rights of complainant had been respected. It is only as an aid in the administration of this primary rule that it has any virtue. The same rule to which it owes its existence requires its subordination to any more accurate criterion of the actual equities of the respective parties which the circumstances of the case may afford. An indiscriminate application of it, as if it were the ruthless master instead of the pliant servant of the court of equity, would, in this class of cases particularly, lead to enormous injustice, doubly so if coupled to speculative modes of estimating profits which tend to accumulate upon single steps in a complicated manufacture many fold the actual profit possible to be made out of the entire manufacture with all the varied elements and agencies that enter into it. *See cases above cited.*

Fourth. That where a royalty has never been paid for the use of the invention as originally exhibited in the patent, but only after its incorporation in subsequent improvements,

that royalty must be apportioned between the original invention and the subsequent improvements; and where one royalty has been exacted for it in its original form, and another after it has been improved on, the former rather than the latter affords the proper measure.

The only license that appears to have ever been made before the process and apparatus had undergone extensive modifications, representing years of subsequent invention, is that of Moinier & Co. (p. 392). This gave the exclusive right to the monopoly, with all subsequent improvements, for all France, the principle candle manufacturing country of the world. This was a much more valuable right than a mere non-exclusive license. The royalty fee for this exclusive right was about two cents per hundred pounds on the first five million pounds, and about four cents thereafter. This gave the licensees exclusive right, not merely to the particular apparatus and process shown in the patent, with all "convenient vessels" included under the patent, but all the improvements thereon that might afterward be made by Tilghman.

The twenty cents per hundred license fee was only adopted after there had been substituted for "any convenient vessel" known to the art at the time, an organized machine applying agents that were excluded by the implication of the patent, and effecting results not attainable by any means known to Tilghman or any other worker in the art until developed by years of experiment and invention, and including, among others, the modifications embraced in Tilghman's 1860 patent. Where seven per cent of lime was used half this royalty was charged (p. 1110).

Fifth. That, it appearing from complainant's evidence that complainant was, during the entire term of the infringement, owner of only a fractional interest in the patent and the royalties, profits, and recoveries thereunder, and complainant having failed to show what the extent of that fractional interest is, the recovery can only be nominal damages.

Tilghman sued as owner of the patent which was granted to him. In the progress of the account it appears from his own witness (*B. C. Tilghman*, *p.* 1248, *a.* 9–10), that he is, and has been throughout, the owner of only a fractional interest in the patent and in all rights accruing thereunder. The extent of his fractional interest does not appear; the burden was upon him to make it appear. It is not simply a fractional interest in the recovery that is outstanding, but an interest in the patent itself and every thing growing out of it. What damage the complainant has suffered or what profits he is entitled to recover can not be ascertained in the absence of a showing as to the extent of his interest. It is not a disability to maintain suit, but a limitation upon the extent of damages or profits to be recovered, that arises under this state of facts. Complainant can not, even after interlocutory decree, obtain further affirmative relief, when he discloses, in seeking it, his lack of equity to it.

In *Jones* v. *Morehead* (1 Wall. 155), the interlocutory decree had, in terms, passed upon the question of infringement by the devices involved in the account, but the court held that, even under that decree, complainant could not have a recovery which, upon the facts disclosed in the account, he was not entitled to, notwithstanding the finding in his favor in the interlocutory decree. That case goes much further than it is necessary to go in the present case. The fact disclosed upon the account was one specially within the knowledge of complainant, and in the ascertainment of which defendants were guilty of no laches. Any advantage that might have been obtained from it as affecting the interlocutory decree may be lost to defendants, but any effect which it has upon the question of profits of which complainant has been deprived, or damages he has suffered, must be accorded it in the computation of such profits or damages.

Sixth. That when the tribunal of last resort had construed the patent as limited to the specific device shown, that

construction of it became a restriction on the scope of the patent, and so remained until revoked; that during the period this construction remained unmodified, no person could incur liability as infringer by acts which did not trespass upon it as so construed; and that defendants are not chargeable for any infringement between the date of this decision (March 2, 1874) and the expiration of the patent.

It is with reference to the law, as construed by the court of last resort, that the public have to regulate their conduct. The construction placed upon a statute, a grant, or an instrument, by that court, controls its legal effect, and by that construction the lawfulness of every act committed while it remains unmodified must be determined. When the Supreme Court had construed this patent, it was by their construction of it, as if introduced into the very language of the patent, that the public were bound to govern their action. These defendants abstained from any trespass under it as thus construed, and during that time are chargeable with no infringement.

Seventh. That where the construction of the patent was so doubtful, that the Supreme Court once authoritatively construed it to the same effect as the defendants have, a court of equity ought not to assess interest against defendants; and that it would be specially harsh and unjust to assess interest over the time intervening between the first construction of the of the Supreme Court and its recent reversal, when defendants were acting in accordance with the decision of that court. Defendants should not be punished for withholding a payment this court had decided they did not owe.

What has been said under the last preceding proposition is applicable here. Beyond this, whatever discretion the Chancellor may have in a case in equity about allowing or withholding interest, should be exercised to mitigate the severity of a decree which visits heavily upon these defendants the consequences of the revolution in the opinion of the court. After relying more than ten

years upon the carefully considered opinion of the court, and regulating their conduct and business enterprises accordingly, this decree falls with peculiar severity upon them.

If that opinion had been otherwise, they would have had the alternative either to proceed under payment of royalty or adopt some other process. If this Court were now to visit upon them any judgment beyond such royalties, it would be in effect placing upon them a penalty for having governed their conduct in accordance with that opinion, while no such penalty is necessary to do complete justice to the complainant.

Complainant has urged that because defendants were persuaded to cease paying royalties to Tilghman by an attorney who represented other defendants, in litigation then pending adverse to the patent, an especially severe remedy should be administered. If defendants had themselves incited or organized a defense against the Tilghman patent and if it had been so evident that the patent was valid and entitled to the broad construction now given it as to exclude the presumption of good faith in making such a defense, there would be more reason in this argument, though it would still be inconsistent with the administration of equitable relief. But the facts are the precise reverse of this. Defendants did not induce others to resist the patent, or instigate opposition to it. They continued to respect the patent when other manufacturers, acting under the advice of counsel, had ceased to do so. This placed them at special disadvantage in the market. When advised by reputable counsel that they were not liable to royalty, they exacted the strongest assurance of good faith that this counsel could give them. When the distinguished counsel who represented the defendants in the litigation then pending, including Mr. Evarts, Mr. Kellar, and Mr. Collier, were advising that the defense against the patent was complete, when the case was so strong that this Court not only hesitated but in the first instance decided in favor of defendants, it certainly can not be said that the defend-

ants are not entitled to the presumption of having acted in good faith. If there was a conspiracy, they were the victims, not the promoters of it. If there was a probability of its being determined that Tilghman was not entitled to royalty on their apparatus, the only prudent course for them was to withhold that royalty pending the litigation. If it was withheld, and the litigation determined in his favor, it was still possible for him to be made whole by a recovery of it, or so much of it as might be due him. If, on the other hand, they continued to pay, and the determination was ultimately adverse to Tilghman, they could not recover back the royalties so paid over. The course they took was not only a reasonable one, but it was one which was afterwards justified by the decision of the Supreme Court as then constituted; and while that decision has been reversed, it would be a harsh rule which held these parties responsible for falling into an error in which they had such company.

Eighth. That the invariable rejection of this process by all who endeavored to use it in its primitive form, and the continued use of older processes, both during the term of the patent and since its expiration, by manufacturers who were familiar with this, and to whom it, with all its improvements, was open, afford the most convincing proof that the patented process was incapable of adding any such enormous profit as that attributed to it by the Master; that the correctness of the verdict thus pronounced is confirmed by further tests on a working scale; and that speculations or estimates inconsistent with these facts must be treated as unsound and misleading.

An inventor can usually figure out on paper a value for his invention, enormously in excess of anything that can be practically realized from it. He can furnish statistics and calculations by which to demonstrate his estimates. He can do everything except realize those estimates. When it comes to this test there is some equation which has been overlooked, the scientific nature of which may elude detection, but the economic effect of which wipes

out the product of his calculation and wrecks all his fascinating theories. When the most searching scientific criticism fails to discover any flaw in his estimates, the most skillful practical working often fails to obtain any part of his results. His estimates are in the field of romance. The practical results have to be worked out in a sterner field, where unknown quantities often swallow up known, and where unforeseen commercial conditions are apt to become a controlling factor. Any award which discards the facts furnished by practical working and substitutes for them the estimates which are in irreconcilable conflict with such facts, is certain to be unjust and liable to be ruinous.

PRACTICAL ECONOMY OF COMPLAINANT'S PROCESS.

First. The question of the practical economy of the patented process, as compared either with older processes or with the subsequent modifications used by defendants, are distinct from the question of utility and infringement heretofore determined.

This Court has held that complainant's patent can not be impeached for want of utility; but the question of the comparative economy of it and older processes was not involved in that issue. Where want of utility is urged against the validity of a patent, the question is not one of comparative utility — whether the invention is better or worse than something that went before; but simply whether the invention is capable of operation for some useful purpose, or, in other words, for some purpose not pernicious. The presumption is always in favor of such technical utility as is necessary to sustain the patent, and the burden is heavily upon defendants who are attacking its utility. When the question arises upon account as to the extent of the practical advantage of the patented improvement, the burden is shifted, and the complainant must prove affirmatively, and by definite and satisfactory

evidence, any comparative practical utility that he relies upon as a basis of recovery. Evidence that would effectually protect a patent against an attack for want of utility, where the question of its validity was to be affected, would often fail to afford such proof of affirmative value as to support any recovery. Indeed, the very evidence which would protect a patent against impeachment for want of utility might affirmatively demonstrate its deficiency in economic utility over other known methods, and limit the complainant to a nominal recovery.

So, too, when the Court determined the defendants' apparatus to infringe the patent, it did not, and could not, determine the extent to which the advantages of defendants' manufacture were attributable to what was borrowed from the complainant's patent, and how far they were due to modifications introduced into, or superadded upon, the original invention. The Court in terms disclaims passing upon these questions. If pertinent at all, these questions are now before this Court for the first time.

Second. The concurrent experience of all who undertook to use the process for practical purposes, aided by every suggestion as to "convenient vessels" Tilghman was able to make them, or that was available in the art for some years after the patent, shows that its practical disadvantages, when applied on a manufacturing scale, more than offset its theoretical advantages.

From the testimony of Moinier (p. 345), it appears that Tilghman, soon after his patent was out, went to Paris, the very head-quarters of saponifying fat, and to one of the largest establishments there, and undertook to put this process in practical operation. He made a contract with this establishment by which it was made immensely to its advantage to make the process operate successfully, if it were possible. By this contract he gave to Moinier & Co. the exclusive right under this patent and all improvements for France (the foremost manufacturing country in this art) for the full term of the patent, upon a royalty of five thousand francs for the first two and one-

half million kilograms of fat treated, and five francs per thousand kilograms for all in excess of this amount. If the process had been capable of making one-tenth part the saving now claimed for it, Moinier & Co. would, under this contract, have been in possession of an enormous monopoly. No stronger inducement to make the experiment successful could have been offered. They spent forty thousand francs in the effort. They had not only the benefit of the patent, but the personal presence and suggestions of Tilghman, and his brother, who was interested with him in the patent. They had every facility that a leading manufacturer, in the leading city in this art, could command. If there were other "convenient vessels" then known and capable of being applied in this process, Tilghman had the opportunity of introducing them, and Moinier & Co. the strongest incentives to avail themselves of them. The experiments were continued for some time. Though it be conceded that they did not establish the inoperativeness of this process, it is certain that they demonstrated its want of commercial economy to the satisfaction of the manufacturer who had evidenced by his conduct his desire to avail himself of any advantage it might afford, and who had the strongest interest in its success.

It is significant that, during all these experiments, neither Tilghman nor others thought of the modifications in apparatus and conditions which were developed by years of subsequent experiments, and are now insisted upon as obvious expedients.

Moinier testifies, in answer to fifth interrogatory (p. 346):

"We made numerous experiments relative to the patents immediately after signing the contract. They were made by Mr. Tilghman, aided by some of our workmen. Personally I have never assisted with my own hands at these experiments. I contented myself with being present, as was my right and my duty. Mr. Richard A. Tilghman, the possessor of the patent, was present, and worked at the first experiments with his brother during ten or fifteen days. Mr. Richard A. Tilghman, on leaving

the factory, left his brother to represent them with my society and to continue and to direct alone the experiments described in the patents."

In answer to the sixth interrogatory, he says:

"The results of these first experiments, as well as those that followed, were entirely useless, and productive of no good. . . . Although the mixture of water and fatty matter was, during its passage in the coil, subjected to a temperature which I estimate to have been above five hundred degrees (500°) and a pressure of more than twenty atmospheres, the decomposition of the fatty matter was never complete, and never produced fat acids and glycerine, but only an altered fat matter, which, when washed, produced acroleine to such a point as to fatigue the workmen who assisted at the experiments."

Also in the seventh interrogatory,

"All the experiments were made in conformity to Mr. Tilghman's directions in his said patent. As I have already stated, Mr. Tilghman, the patentee, and his brother, were personally present at the said experiments, which they directed. The placing of the apparatus and the conducting of the experiments were for them alone, and under their exclusive directions."

"I satisfied myself, after two different trials, that Mr. Tilghman, with his method and apparatus, could not, at our factory, produce fat-acids and glycerine. I say and believe that any manufacturer using this method would not succeed better than the inventor, Mr. Tilghman, nor be able to draw any profit from it."

Tilghman, in order to meet this testimony, testifies that he did make these experiments work. We can quite afford to concede that these experiments were worked to Mr. Tilghman's satisfaction, so far as convincing him that fat-acids and glycerine could be got by that process—an interesting laboratory experiment, as demonstrating the scientific fact, which, while it may be sufficient for the purposes of determining the validity of the patent, is not sufficient for the purposes of giving more than a nominal

recovery in the way of profit or damages. Whatever might be said about the relative weight to be attached to the testimony of these witnesses—whether Mr. Tilghman, a strongly interested party, and having his imagination and his interests working upon his memory for years before he testified, or Moinier, who has no interest in this litigation, is entitled to the most credit in their testimony as to the operativeness of the process—it is quite sufficient, when we come to the question of practical advantage, that the transactions, measured as they must be, too, by the considerations that must have been operating upon the two parties, show that they did not demonstrate its practical, economic utility to a sufficient extent to induce this company to continue to use it, even under conditions which, if it possessed any considerable advantage, would have given it the control of the art in France.

Puffs given to Mr. Tilghman at the time Moinier was contemplating introducing this or experimenting with it, fascinated by the theories that Mr. Tilghman had imparted to him, puffs for advertising purposes, if ever to be considered as evidence, can have little weight against the outcome of these business transactions.

Tilghman now abandoned France for England, and went to Price's candle factory. It was certainly under a management that was eager for the introduction of experiments. Tilghman had the advantage of any experiments made meanwhile, but still had no "convenient vessel" that would enable the manufacturer to use the process on a commercial scale. It was tried and objected to, as not of commercial utility, though its beauty as a chemical experiment was conceded; finally, after modifications had been made by Mr. Wilson and his engineer, Mr. Cooper, it appears to have been applied on a limited scale for the treatment of palm oil, a fat that is more readily decomposed than others, and which is not involved in this controversy. The Tilghman process, even in modified form, seems never to have superceded the old process in that factory, or to have been applied for any purpose other than the treatment of this exceptional oil.

There is no testimony in the Record that proves that the process, under any modifications whatever, was ever introduced into the Price candle factory. Mr. Tilghman, the witness who testifies as to what was done, says that he never saw the apparatus or the process carried on there; he says he made experiments with his coil apparatus in the factory of the Price Candle Company. They declined to use his process as exhibited by him. Mr. Wilson and Mr. Cooper insisted upon modifications.

On page 112, in a paper from Mr. Wilson, which is introduced by the complainant, speaking of Mr. Tilghman's experiments, he says:

"He proposed to effect this by pumping a mixture of fat and water by means of a force pump, through a coil of pipe heated to about 612° Fahrenheit, kept under a pressure of about 2,000 lbs. to the square inch."

This paper is in 1856, two years after the date of the patent.

"And he states that the vessel must be closed, so that the requisite amount of pressure may be applied to prevent the conversion of water into steam. This is, all must admit, a beautiful, original, chemical idea, well carried out; it has yet to be proved how far it can compete successfully with distillation. We have made an arrangement with Mr. Tilghman, which will give us the means of testing its commercial merits.

"I went with my chemist assistant, Mr. Payne, to see Mr. Tilghman's little apparatus at work, and in the course of some experiments which it led us to try, or rather to try over again, it struck me that steam passed into the fat at a high temperature should effect by a gentle process what Mr. Tilghman aimed at effecting by a violent process, the resolving of the neutral fat into glycerine and fat-acids. We proved that this was so, and that the glycerine distilled over in company with the fat-acids, but no longer combined with them."

That is he found more practicable the distillation pro-

cess which has been ridiculed by complainant as inoperative.

A letter written from Wilson to Tilghman under date of July 13, 1865 (more than eleven years after the date of this patent, and more than five years after Tilghman's 1860 patent had been issued), and evidently in answer to a letter from Mr. Tilghman, describing the modifications that had been introduced, is significant as showing by what slow stages these modifications were worked out, and the importance attached to them as they appeared (p. 842):

"*Dear Sir:* I thank you for your letter of 19th of June, which I have laid before the Directors to-day; and they will be much obliged if you will, as you kindly offer, procure for us tracings of the working drawings of the apparatus now in use for your process in America, and most approved by you, at any such cost as you mention—of about twenty dollars. You will tell us, in sending them, how to pay the money.

You are right in supposing that the apparatus we have now at Battersea is just what you saw or heard about when you were here. There is a stirrer in each vessel, but plainly insufficient for the proper contact of the water with the fatty body. I should think we may very probably use our present digesters for the outer iron vessels of your apparatus, putting them, of course, up on their ends. They are very much the shape of the vessels you describe. You do not mention what quantity of water you put to the fat. I should think it might be well to put it in at two doses. Drawing off the first when it has taken up the bulk of the glycerine, and then finishing off with fresh water, to take the last part of it away; using this water again as the first water for a fresh charge of fat. But, very likely, you already do this. The whole of your letter now being replied to, as well as of the previous one, was of much interest to us. If any further matters occur to you as worth mentioning, in connection with the working of the process on your side, we shall be much obliged by your stating them when you write again."

A letter from Tilghman to Thomas Emery & Son, of Cincinnati two years and a half after the date of his patent shows that his experiments in London and Paris were

not as satisfactory to him at the time as since represented, and that he had already realized the necessity of making substantial modifications, though he had not yet developed the plan that some years afterward gave the first results that were commercially practicable (p. 841):

14 SOUTHAMPTON PLACE, EUSTON SQUARE,
LONDON, June 25, 1856.

THOMAS EMERY & SON, Cincinnati.

Gentlemen: I have received from Mr. Davenport your favor of 30th of May, last. Our experiments in the factories here and in Paris have shown that, on the large scale, the decomposition of fats by water is more conveniently effected by modifying the apparatus originally proposed, so that the fat and water are exposed to a comparatively lower heat and pressure for a longer time, instead of a very high pressure for a few minutes, and a considerable quantity of material is treated at one charge, in an ordinary steam boiler lined with lead or copper and provided with an agitator, in place of using the continuously-working pumps and coil of pipes. At a pressure of 225 pounds per inch tallow or palm oil or lard stearine is completely decomposed in five hours. In the course of a few months we shall probably have going on at Price & Co.'s works an apparatus on the above plan capable of treating several tons per day. Until my process is in actual use in England I have decided not to begin its introduction into the United States, and, therefore, can not at present reply to your request as to terms of sale. As soon as it is well established here I intend returning home, and will immediately communicate with you. I give below answers to such of your questions as I have materials for, and remain,

Very respectfully yours,

R. A. TILGHMAN.

Even with these modifications, the apparatus does not seem to have ever been used practically for the treatment of tallow in Price's factory.

Tilghman's next effort was at the factory of Grant, in Philadelphia, in 1859. Here again he had the best facilities, and the manufacturer had large inducements to succeed. Such modifications as had been introduced between 1854 and 1859 were available. Tilghman was pres-

ent to superintend and assist. The result was a rejection. Grant testifies that he had been in the business of manufacturing adamantine candles for eighteen years; that from the Fall of 1859 to very nearly the beginning of 1862 they were trying the Tilghman process, but not using it continuously. He is asked (p. 371):

"*Q.* 8. In such process, as operated by you, did you employ a coil apparatus such, or substantially such, as that shown in the drawings annexed to said letters patent?

A. No.

Q. 9. What form of apparatus did you employ?

A. A cylindrical digester, with spherical ends.

Q. 10. From whom did you procure it?

A. From Mr. Richard A. Tilghman himself. We used two; the first of which was furnished by him, and the second one we had made.

Q. 11. Will you now state how long you used this process; the manner in which you used it; the heat and pressure employed; and the result of the process?

A. From the time we commenced to use it until we ceased to use it was about two years. We used it in connection with a high pressure boiler, and with fires underneath the digesters. The heat was—the pressure was about one hundred and sixty pounds to the square inch; and the heat was such as would be indicated by that pressure. The result of that process was a decomposition into fat-acids and glycerine, which, from its dissimilarity to fats of like kinds which we had decomposed by the old lime-saponification process, we concluded were imperfect. There was a deadness of crystalline or granular formation, such as we were accustomed to in the old lime-saponification process.

Q. 12. Was lime employed by you in the Tilghman process? If so, state the percentage of lime used relatively to the fat.

A. We used the process, a portion of the time, without any lime; a portion of the time, with a half per cent; sometimes with one per cent; and sometimes, occasionally, with a higher percentage.

Q. 13. What provision, if any, was made for the agitation of the fat during its treatment?

A. It was agitated by paddles on a shaft running through the digesters from end to end.

Q. 14. Did you ever use the process without this agitator, and without steam generated in a separate boiler from that in which the fat was contained?

A. We never used it without the agitator. I think we never used it without steam.

Q. 15. Was there any change in the mode of generating and communicating steam to the digester in which the fat was contained? If so, state what such change was.

A. I think, at first we used a low-pressure boiler, until the pressure in the digester was equal to that in the boiler. Subsequently we got a high-pressure boiler.

Q. 16. State whether or not you voluntarily abandoned the use of the Tilghman process; if so, why?

A. The primary reason was that we found it was costing us too much. We had abandoned the attempt to make candles successfully by the process alone, and had tried it in connection with distillation, sometimes by distilling the stock or fat-acid after it had been decomposed in the Tilghman digesters, and sometimes mixing tallow that had been decomposed in the digesters with palm-oil that had been distilled after decomposition with sulphuric acid. The distillation of fat-acids decomposed in the Tilghman boiler was very gassy when about two-thirds of the distillation was complete. The candles made from a mixture of tallow decomposed in the Tilghman boiler, and palm-oil acidified by the sulphuric acid process, and distilled, were of a grayish tinge of color, and inferior to those made by the sulphuric acid process, and sold at less prices on that account. Toward the close of our use of the Tilghman process, we used less proportions of tallow decomposed in them, and larger proportions of palm-oil distilled after acidification by sulphuric acid, and got better candles.

Q. 17. Did you ever make candles from the product of the Tilghman process alone; and, if not, why not?

A. I don't recollect that we ever made any by that process alone; but we may have done so. We could not make a good-colored stearic acid. We could not make the material press right. It was too dead or ungranular, which was one of our reasons for endeavoring to work it with the palm-oil acidified with sulphuric acid and distilled.

Q. 18. Were you able to make a good candle by distilling the fat after it had been treated by the Tilghman process?

A. Yes.

Q. 19. Was this a profitable mode of treatment?

A. No, it was unprofitable.

Q. 20. What supervision, if any, was exercised by Mr. Tilghman, the patentee, of his process as practiced at your manufactory?

A. He was there frequently. He suggested all the modes of treatment. He advised that, although the water would thoroughly decompose the fat, he considered it better to use a little lime, say one-half per cent., to hasten the operation." . . . .

"*Q.* 35. State whether the employment of the Tilghman process by you was profitable or unprofitable.

A. It was unprofitable; that is to say, the profits of the business were not equal or nearly equal what they would have been by the sulphuric acid process."

In another deposition he testifies concerning the same (p. 1050):

"*Q.* 9. For how long did you use such process?

A. From the time we commenced until we finally abandoned it, I think, was about two years. There was quite an interval between the time we stopped using it regularly and the time that we made some final decompositions with it.

Q. 10. Why did you abandon it?

A. Because we couldn't make satisfactory candles, or make them as cheaply as we could by the sulphuric acid process.

Q. 14. Did you at any time manufacture candles from the product of that process alone?

A. We might have made a few candles, but we never made a day's moulding of them.

Q. 15. What did you do with the product of such process, prior to its being made into candles?

A. We mixed it, before pressing, with stock that had been distilled, and by this process we made most of the candles during the period we had the water process in use; but we distilled, for a time, the whole product of the water decompositions."

Ten years after that experiment, he testifies that he is still engaged in decomposing fats: (p. 1046 a. 4–6), and still uses the distillation process.

Mr. Tilghman had at that time modified his process, not only in respect to the use of a very substantially different degree of heat and pressure, but he had introduced the highly heated steam within the tank, and instead of one digester heated as his coil apparatus was heated by fire directly applied (the only mode of applying heat to any kind of apparatus suggested in his patent), a digester connected with a steam boiler, from which the steam was introduced into the digester. To do this, he had necessarily abandoned the conditions of pressure and temperature mentioned or suggested in his patent, which would have been incompatible with the introduction of the free steam within the digester. If you introduce steam in the digester, you must have free communication between the digester and the boiler. This subjects the boiler and all connections to the same amount of pressure that you have in the tank. Now, while it is a comparatively simple problem mechanically, to introduce steam under a pressure of two or three hundred pounds, the problem that is presented when you come to introduce steam from a boiler into a tank, or any capacious receptacle where the pressure is anything approximating the pressure required where water and heat are the sole agents, becomes a stupendous one; one which has never been solved in the use of this process, even to this day; one which Professor Smith says, would be an impracticable one. (p. 913 a. 17–19.)

While the repeated cautions in Tilghman's patent against allowing steam in the heating apparatus has been held not to limit his patent to a case where steam was excluded, it certainly tended to point those who undertook to use his invention away from rather than toward the introduction of this agent, and the history of his own experiments shows that he was years in finding the importance of the introduction of the steam within the tank. As long as external heat was used, whether a coil or other "convenient vessel" was employed, but a very small amount of fat could be exposed at once, and that fat was in danger of being so scorched on the outside as to give

off acroleine, and be thereby rendered of no commercial value, while receiving less heat at the center than was necessary to accomplish the decomposition. If a tank of any size was used, the enormous thickness, made necessary by the high pressure, increased this difficulty. Any stirring or mixing of the fat and water by mechanical means within the tank was also rendered impracticable. Accordingly, the patent proposed to effect the emulsion before introduction into the tank, and simply rely upon the circulation to cause the water and fat to "remain in the same state of intimate mixture in which they entered." No provision for preserving that mixture, which would have been applicable to any other than the coil apparatus, is suggested, and no mechanical means seems to have been found that was efficient for the purpose, until the forcing of counter currents through the fat and water by means of the pumps working inside the digester, was adopted. Even if a mere stirring apparatus would have answered, (and the evidence is to the contrary), there would be great practical difficulty in so supporting and packing it that it could be driven by external means, where the internal pressure was at any degree approximating that provided in the patent. This high pressure would have excluded the application of any ordinary mechanical stirrer, where the work was to be one on a commercial scale.

Tilghman had now, as the result of several years' experience, adopted modifications which carried his process from two thousand pounds pressure down to about two hundred. He had introduced the percentage of lime, the steam from the connecting boiler, and the mechanical agitator operating simultaneously with the heat and pressure during the process of decomposition. We can trace the development of these modifications through the experiments of Wilson and his engineer in Price's factory, through Tilghman's own experiments, through the Melsen patent, the DeMilly patent, and the Wright & Fouchè patent, all of which had come out meanwhile; but with these modifications Tilghman was only able to slightly lessen

the completeness of his failure as compared with the Moinier tests. It was still a failure. Grant, as a matter of business economy, was forced to go back to the older acidification process.

Tilghman's next effort was in the Ropes factory, in 1860. The witness, Ropes, was a licensee when testifying, and kindly disposed toward Tilghman, but he has, like the others, to confess that the first experiments were not successful, and that it was only about the time that Tilghman's patent of May, 1860, issued, that they began to get results that satisfied him that he could afford to use the process, and then they got them by the use of modifications over and above those which were used in Philadelphia. It was in August, 1860, some months after Tilghman's second patent, that Ropes became satisfied that he could afford to use the process. Ropes, Jr., says (p. 567):

"*Q.* 3. Please state whether you have been working under Mr. Tilghman's process. If yea, how long have you been working under that process, and under whose direction or superintendence?

A. We have been working under it, or I should say, rather, we have been experimenting with his process until lately. The reason I say experimenting, is because Mr. Tilghman, when he first came here, informed me that he never had an opportunity of operating largely with lard stearine."

This deposition was taken April 3d, 1860.

"We began experimenting about the beginning of January. These experiments were not satisfactory as to the quality of stock until recently. The stock, apparently, was not well crystallized. The glycerine did not appear well separated from it. He has succeeded well recently. The stock, I may say, is beautifully crystallized. It is so well crystallized, apparently, that we have no more trouble in separating the red oil and margerine than under the old process."

This is significant as to the efficiency of the lime. One-half per cent of the lime (that is, less than these de-

fendants used by half) effected in six hours what, without it, required twenty.

"*A. to Q.* 5. We have worked only twice without the use of lime. The first time it was not all crystallized, nor did it give us satisfaction. The last time, as I said before, it was beautifully crystallized. But the objection to working in this way is the time it occupies, say twenty hours, to produce an unexceptionable article."

It appears further on, that when he got these results, he also used the changes of water and the charge of steam, heating all together by steam brought into the tank.

Ropes, Sr., testifies, referring to this same use, but describing it somewhat more specifically (p. 135):

"In the twenty-hour operation, the quality of the stock produced was rather inferior. The glycerine did not appear to be removed. We were not satisfied with the result. There did not appear to be a perfect separation of the glycerine, margaric and stearic acid in this twenty-hour operation; but in the twelve-hour operation, with two thousand pounds of prime stearine, and the same quantity of water introduced, one thousand pounds each time, a beautiful result was produced."

Here we strike this introduction of the successive charges of water, which was made one of the subjects of Mr. Tilghman's 1860 patent.

"We have not repeated the operation since then without any lime, not because we don't think them practicable, for I fully believe that under pressure—well, say of two hundred pounds to the square inch, which would give something like four hundred of Fahrenheit, I should suppose—as good a result could be obtained, in as short a time, as with a half pound of lime under a pressure of only a hundred and fifty pounds to the square inch. This last is, as I say, a matter of opinion, without having tested it." . . .

"There would be a great risk from explosion in putting on more pressure."

In answer 6, he describes his steam boiler so constructed that the steam agitates the fat.

Third. The modifications in apparatus and conditions which had to be made before the process became capable of competing with others for manufacturing purposes, were developed through years of experiment, and were the subject of intermediate patents by other inventors and by Tilghman himself.

Most of the modifications that had now been introduced can be traced through intermediate patents in this art.

In the Melsen patent of December 18, 1854 (p. 317), we find provision made for distributing water in jets, the use of the connecting boiler, the use of lower degrees of pressure with the acidification of the water, and the circulation of the water through the fat.

In the DeMilly patent of November 19, 1856, claim 3 is:

"The employment of the agitation of steam for effectin a stirring or combination between the fatty bodies and the lime, instead of employing any mechanical agitation."

And claim 6:

"The heating the vessel internally, and the elevation of the mixture by a jet of steam produced in a separate generator, and acting separately at a higher and proportional pressure, as hereinbefore described." (p. 318.)

The Wright & Fouchè patent (p. 280), which was issued in England April 1, 1857 (see p. 315), and in this country January 25, 1859, exhibited the connecting boilers, the introduction of the continuous current of steam highly heated from the boiler, and the circulation of the water in counter currents through the fat, and the use of the double casing, providing for this circulation. Shortly after this Wright & Fouchè patent issued, that is under date of July 20, 1857, Tilghman wrote the following letter, in which he recognizes as recent improvements, and as substantial departures from his original apparatus some of the modifications that are traceable to these patents (p. 473):

To M. DEFONTAINEMOREAU.

Dear Sir: In compliance with your request, I proceed to describe the present state of the apparatus for decomposing fats, as it is now being worked at Messrs. Price & Co.'s

As I have before mentioned to you, it consists of a boiler thirty-two inches diameter and thirty feet long, made of iron, nine-sixteenths thick, and lined with copper.

It is heated by an interior copper sepentine, a *retour d'eau*, which is supplied with steam from a smaller tubular boiler (thirty-two inches diameter by ten feet long, with eighteen flues, three inches diameter). It has also a tube pierced with holes to inject free steam. The apparatus is worked at a pressure of from two hundred to two hundred and twenty-five pounds per square inch (fourteen to fifteen atmospheres); it is charged with two and a half tons palm oil and three-quarter tons water; and the oil is perfectly decomposed in four and a half hours after the above pressure is attained. The decomposition would be effected in a shorter time if a larger proportion of water was employed, and if agitation and mixture of the materials was produced by the irjection of free steam from the pierced tube; but, as one object is to get the glycerine in a strong state (the demand for glycerine being just now greater than they can supply), they prefer, for the present to work it as described."

In 1860, Tilghman took out a patent for what he would now represent to be merely obvious modifications of his original "convenient vessel," but what he then evidently regarded as new and important inventions. In the specification he says (p. 300):

"My invention relates to the process of obtaining free fat-acids and solution of glycerine from fatty substances by the action of water at high temperatures and pressures, and it is applicable either when water alone is used, or when, in addition to the water, a portion of alkali is used to aid the chemical action. I have observed, in working this process, that though the action of the water in extracting the glycerine from the fat is rapid at first when the water is fresh and the fat contains all its glycerine yet as the decomposition advances, and the fat gradually loses, and the water takes up the glycerine, that the

decomposition becomes slower and slower, so that to extract the last portion of glycerine from the fat with a moderate quantity of water requires a considerable time when the lower range of pressure is used.

Now, if we use a large proportion of water to a given quantity of fat, the decomposition may be made sufficiently complete in a moderate time; but this has the inconvenience of occupying a considerable portion of the vessel or apparatus used, and thereby diminishes the quantity of fat that can be treated therein.

Now, my invention consists in applying the water to the fat in several successive portions. I remove the first portion as soon as it becomes partly saturated with glycerine, and I add successive portions of fresh water to the partly decomposed fat, which fresh water is more active in taking up the last remaining glycerine of the fat, and thereby I render the decomposition more rapid and complete, and can treat a larger quantity of fat in a given apparatus."

He then proceeds to describe a method of creating counter-currents of water and fat in the digestor, telling us that in the arrangement of this form of the apparatus there are two features which form distinct parts of his invention.

"As fat and water dissolve each other to a very slight extent, their action upon each other is much accelerated by a large surface of contact. This large surface of contact has generally been produced by a mechanical agitation and mixture of the two liquors; but as this mixture is almost incompatible with a perfectly continuous form of apparatus, I have devised plans whereby these advantages of larger contact and renewal of the water may be obtained by other means, either in continuous or intermittent forms of apparatus."

Then, after describing his arrangement specifically, he goes on to the description of his digester, which has an inner tank with a heavy jacket outside of it, the inner tank being perforated. He describes, also, the pumping apparatus which he used in the tank, and says:

"The same principle of using successive charges of

water, and exposing it in thin layers of great surface, can be employed in various ways. It may be used as an intermittent apparatus, where a large quantity of fat is operated on at one time, and kept in till the whole is perfectly decomposed, a mode of working preferred by some manufacturers."

Then he describes how it is to be continuously introduced and removed, and claims;

"In the process of decomposing fats into fat-acids and glycerine, by means of water at a high temperature or pressure, either with or without the presence of an alkali—

1st. Applying the water in successive portions, and removing those portions when partly saturated with glycerine;

2d. Arranging the fat and water in shallow layers, so as to give an increased surface of permanent contact between them;

3d. Causing the fat and water, arranged in shallow layers, to flow in opposite directions, so as to bring fresh water in contact with the partly decomposed fat."

This shows by what slow degrees was worked out, by different inventors, what looking from the stand-point of the present state of the art back over the entire intermediate period and the entire intermediate art, we are asked to read out of the 1854 patent as its perfectly obvious import. It shows how far short his wisdom then fell of discovering in his patent what his imagination, developed by decades of brooding over it, has injected into it. Now, without any question, but what the use of one mode of heating is, in a process in which heat is an agent, the equivalent of another mode, so far as it affects the question of infringement of a patent for such process, no matter how much better or worse the mode of applying the heat may be, there can, on the other hand be no controversy but what, if any person applying heat in any modified manner, by any modified apparatus or agency, or with any additional facilities, has increased its efficacy, or overcome any difficulty, this is none the less an improvement because it is

an infringement. It is the equivalent of the old agent if it applies heat; but it is something more than an equivalent if it has additional advantages. As an improvement it may be the subject of a valuable patent, and all advantages due it will be accountable under that patent — or, if not patented, these advantages accrue to the public. If, instead of applying heat to the fat by a fire under the digester — a mode by which it would be impracticable to apply a high degree of heat with uniformity through any large mass of fat — the process and apparatus are both so modified as to introduce and preserve within the digester a constant source of heat, through which the water can be caused to pass and repass, thus being itself supplied with that heat as it returns repeatedly through the fat — if thus inherent difficulties in the problem presented by the original patent are overcome, those modifications become distinct, and it may be quite important, improvements not to be credited to the original invention, though not escaping the original patent. The same is true where there is introduced an improved method of agitating the material within the tank, or of causing the water and the fat to flow back and forth within the tank — a mode especially adapted to the use of the tank or to the conditions of this process, which enhances the efficacy of the process, and increases the profit of the operation, and which, even if falling within the scope of the original patent, and not escaping the charge of infringement, yet represents a superadded improvement, or an additional or better agency, by which better or more economical results are accomplished, or difficulties that have practically prohibited the use of the process in its original form are overcome.

So far as any rights Tilghman may have under this 1860 patent is concerned, it is sufficient that it is not involved in this suit. If it had not been very considerably limited and qualified by intermediate patents, so that the essentials upon which it seems to rest are practically represented by patents that had come in between 1854 and 1860, it probably would have been the patent to which

Mr. Tilghman would have traced, with much more plausibility, too, all the profits of the process as it has been operated in manufactories since the date of that patent. We should be shown how this Tilghman patent of 1854, however interesting it might be, had never accomplished practical results, and the outcome was due to the later invention.

It is claimed in behalf of Tilghman that he had experimented with other apparatus than the coil before the date of his patent. This other apparatus was a little digester, a few inches long, having what he terms a jumper in it. The mode of agitating the fat was to move the digester back and forth and by the motion thus imparted to it to oscillate the jumper, not a very practicable mode of operation with a digester weighing as many tons as would be required in working for commercial purposes, but a fair illustration of the difficulty he encountered in trying to provide a mechanical means for agitating the fat when under such pressure. It is not strange that he came to the conclusion that the coil apparatus was the best mode known to him, imperfect and unsatisfactory as it proved. These experiments certainly brought him no suggestion of the modern digester, and it is enough for the purposes of this account that he has by his patent conceded the results obtained to be inferior to those got by the coil apparatus.

Prof. Booth, an expert in behalf of complainant, makes a sketch of a variety of organizations which he says might have been used, but which he admits never were known in that art or made capable of such use, and which were not adapted to any use involving high pressure. If such devices had been known as capable of adaptation to this art, or in any such way that their use would be suggested to those skilled in the art, we must presume that Mr. Tilghman was familiar with them and had made his selection from them, when he stated the coil apparatus to be the best known for working his process. If, by the application and adaptation of any of them, better results

could be got than those that were got by the best method known by Mr. Tilghman, it comes with very bad grace for him to say that the public, whom he was undertaking to instruct, were bound to know it, when he did not know it himself. He said, not only in his patent, but by his conduct, that he found the apparatus which he described, and the conditions which he described, the best known at the time.

Prof. Booth is asked, in cross-examination, on page 310, cross-questions 44 and 45, referring to his sketches of devices, which he thinks might have been adapted to this process:

"*Q.* 44. You have stated that, with the several apparatus shown in figures 2, 3, 4, 5, 7, 8, 9, 11, 12, 13, and 14, if made of suitable strength and materials"—a hypothesis here that is quite significant—"the decomposition of fats into fat-acids and glycerine, could be effected by the action of water at high temperature and pressure. Were any of such apparatus designed or intended for such a use?

A. They are not stated to have been so designed.

Q. 45. Have you ever known of either of such apparatus being made use of to so decompose fats; and, if so, which, and when and where?

A. I do not know them to have been so used."

In other words, this expert has picked up little laboratory devices and mechanisms intended for no such condition as this process presented—not adapted to such conditions—not recognized even by Mr. Tilghman as capable of any such adaptation—and with the light of the subsequent art, has told us how they might have been made to answer.

Verdin testifies (p. 442) that he never saw any such used.

Renwick testifies (p. 1083):

"*Q.* 5. From your acquaintance with the state of the useful arts in the year 1854, do you know if there was then known any convenient vessels in which to heat liquids that would, with safety, sustain the pressure named

in the patent, other than a coil of pipes and the generator of Perkins' flash steam apparatus?

A. I know of none others."

He goes on to state the difficulties that would appertain to such a problem.

(*See also dep. Prof. Smith, p.* 913, *A.* 17–19.).

In ascertaining what profit or advantage is traceable to the process as originally exhibited, and what is due to subsequent modifications, it must be remembered that the patent would not suggest modification that were inconsistent with the conditions which it represents as those by which the best results known to the patentee are to be got.

Before assuming any modifications to be obvious or trivial it is proper to consider how far it was necessary to go outside of these conditions, before ascertaining the fact that they would overcome the difficulty encountered in using the process on a manufacturing scale; and how far, reading the patent in view of the conditions which it presents, we are bound to see in it modifications which, until we depart from those conditions, are practically impossible. The conditions mentioned hold us steadily to the character of apparatus that will conform to them. We inquire, what is meant by this convenient vessel, and the patent answers explicitly, "*any convenient vessel that can be heated to the melting point of lead.*" This excludes any inference that appliances whose organization is incompatible with such heat and corresponding pressure are capable of use in this process, and leaves this to be ascertained by subsequent conceptions and experiments, breaking away from the conditions to which the patent pointed. Certainly the patent can not fairly be held to suggest to those skilled in the art any apparatus or agent in its nature unfitted for, or incapable of sustaining, the strain, and enduring all the conditions that are presented in the patent. It is significant, as showing that modifications since introduced were not fairly imported by the patent so far as not to constitute improvements thereon; that, not only did Tilgh-

man not describe, and apparently not think of them, but he had, at the time, such understanding of the essentials of the process, that he was naturally pointed away from—as he pointed every body else away from—the use of appliances and conditions that are only practically available when we make a most radical departure from the temperature and pressure used by him.

Where he speaks of the use of a lower degree of heat than that which he has specified as most desirable (the melting point of lead), he speaks of it, not as to be used with ordinary fat, but as a use which is possible with some kinds of fat, such as palm oil; that is, with a material that decomposes more readily than the tallow or other fat with which he is commonly dealing. He does not suggest that you can go below about the melting point of lead, except when you have that material which decomposes more readily than ordinary fat. The only suggestion in his patent that he can go below that point is as follows:

"The melting point of lead has been mentioned as the proper heat to be used in this operation, because it has been found to give good results; but the change of fatty matters into fat-aids and glycerine takes place with some materials (such as palm oil) at or below the melting point of bismuth; yet the heat has been carried considerably above the melting point of lead, without any apparent injury."

The suggestion there is, not that with ordinary fats there can be any material reduction in temperature, but only that there are certain fats that decompose more readily than ordinary fats, which a temperature reduced to about the melting point of bismuth may be adequate to decompose. He then goes on to give his mode of determining the temperatuee at which the process is carried on, and he gives us various gauges; and it is noticeable that the lowest gauge he gives—that is the minimum for any kind of fat—is that of 440° Fahrenheit.

Every allusion in the patent points as steadily and exclusively to such a mode of applyihg heat, and such a vessel, as conforms to the requirements stated at the outset of the specification.

Referring to the drawing of defendants' apparatus (p. 1560) and the description that is found in the defendant's answer, it will be seen that there is a digester, which is connected with the steam boiler by a connecting pipe. In this digester is an inner jacket, which is perforated, to hold the fatty matter. Over it is a perforated diaphragm, which serves the purpose mentioned in the Melsen and De Milly patents, and in the Wright and Fouchè, of subdividing into fine jets the water which is forced through the fat; there is the pump and the pipe leading above the fat from the piston of the pump; there is the steam space over this diaphragm. The steam is brought in under pressure of about 225 pounds to the square inch. The water, charged with the one per cent. of lime, is pumped up and passed through this steam constantly, and the circulation of the water in a counter-current through the fat, upon which Tilghman lays stress in his 1860 patent, is produced. The fat is held in the inner finely perforated tank, while the water is constantly pumped through it; the water passing first through the steam, in its successive rounds, and thus acquiring its heat, then being subdivided through these perforated plates, passing down through the fat, which rises as the water passes under it, and meets the water that is coming down, and which is so forced constantly back and forth through it, getting this motion in opposite currents, upon which stress is laid in this 1860 patent, as a newly discovered and efficient agency in the saponification. The water by its passage through the steam is constantly replenished with heat, and is sent back after being passed through the steam, fresh for its encounter with the fat. It solves the problem how, practically and efficiently, to apply a high heat and uniform heat, under pressure, equally through all parts of the tank, and all

particles of the fat, as it had not been solved by Tilghman in 1854, and gives the water a much more effective contact with the particles of fat that was obtainable by any means tried prior to 1860.

Fourth. The conduct and experience of manufacturers who, while having knowledge of this process, were so situated as to be unprejudiced by the patent, and at liberty to use it without royalty, is inconsistent with the theory that appreciable savings could be effected by it in either the original or modified form.

As evidence of this character, and exhibiting facts in the ordinary course of business unaffected by any reference to litigation, the testimony of Janssen is entitled to great weight. The witness was a manufacturer of candles in Brussels from 1858 to 1870, and personally superintended all the manufacturing from the grease to the candle. He testifies to their having tried the water process about 1860, describing the digester, and then proceeds (p. 1467, *a*. 10):

"We made many trials to try to make it as we did before (they had been using the lime saponification process) but we could not succeed in making any, and after three months, perhaps six months, can not say exactly, we had to give it up, not being able to make any good candles out of that process."

He describes the provisions they made for forcing circulation, and says that they were using considerable palm oil, the most favorable fat to deal with (*a*. 13).

They gave up the water process, adopted for a while the acid process, then went back to the old lime saponification process with open tubs, which they continued to use for years. As to their means of knowing all that was to be known in the art at the time, he says (*a*. 19):

"Of course, we took a great many informations about digesters at that time, to try to see which was a good one to be used cheaper than our open tub.

We sought information about a great many processes—the Tilghman process, Wright & Fouchè, Melsen's, and Hulterhoff, of Buenos Ayres. Hulterhoff came to my house at that time to induce me to take the Tilghman process—he had worked it in Buenos Ayres—but we did not see any advantage; the goods that he showed us at that time, I recollect they were not nice at all, so we would not take the process. He showed us some samples at that time of the candles and fat-acid, but I didn't like it at all, so I gave up the process altogether, and afterward I heard that Mr. Hulterhoff had failed himself in Buenos Ayres; that is a known fact.

Q. 20. Was it before or after you made your experiment with water alone in the digester, that Hulterhoff proposed to you to adopt the Tilghman process?

A. It was after." . . . .

"*Q.* 28. What opportunities have you had of knowing what process was being used in the candle factories of France and Belgium and other parts of Europe?

A. We were always in communication with all the manufacturers of candles, as DeMilly, Labchier, and Butet, the Goude factory in Holland, Wilson Price, in London, Sarg, in Vienna, the Neva Candle Works, in St. Petersburg, and we were always corresponding together to learn improvements, and especially as to water saponification.

Q. 29. Which of these factories to which you have referred have you been in, and seen the process of manufacture carried on?

A. I have seen them all.

Q. 30. About when—during what years?

A. I saw them many times between 1860 and 1870.

Q. 31. So far as you know, how extensively is the process using water under high pressure, without lime, used?

A. None of them, at the time, were using it, so far as I know.

Q. 32. So far as you know, how extensively has it been used since that time?

A. I don't know of any house that uses it in Europe.

Q. 33. Do you know of any who use it elsewhere at present?

A. No."

Following this witness is Baujard (p. 1474), who shows himself to have had special opportunities for know-

ing what is being done in France, and to occupy a position which both gives him an opportunity to keep familiar with all that is going on, and imports that he is an authority on the subject of the manufacture of fat-acids. He was

"Vice-President of the Association of Candle Makers and Soap Makers of France, from the foundation of the society (from about the year 1876) until the time they discontinued business."

He was a manufacturer himself in Paris; and, before the foundation of this society, was a member of one of the committees

"which was intrusted to debate all matters pertaining to stearine makers with the government; and before 1871, I was secretary of the Free Association of Candle Makers,"

He describes the manner in which they grade fat-acids according to the perfection of the saponification or the melting point, and regulate their prices accordingly, and states that he visited all the factories in Paris, and several of those in the interior; saw the process of saponification by water at Besson's factory, by lime at others; that the Besson factory had failed, but had abandoned the water process several years before; that of the twelve factories in Paris, six effected the saponification by lime, five by distillation, and only one by water; that he had never seen the water process used anywhere, except at Besson's; that the product of Besson's factory was inferior in grade and commanded a lower price than that of the others, it being ranked at the foot of the list. This was many years after the water process was open to use in France without conflicting with the patent, and it shows that the old acidification process still continues to compete with the best modern processes.

The conduct of the manufacturers in this country since the expiration of the patent tells the same story.

Emery is called as a witness for complainant to show

the advantage of the Tilghman process. He is a member of a firm which he says is manufacturing in Cincinnati, on as large or larger scale than any other in the West, and has been doing so for thirty years or more. He admits that he has been familiar with the Tilghman process for eighteen years. A letter of Tilghman already cited, shows that his firm had corresponded with Tilghman about it as early as 1856. Since 1860, this process has been open to that company, later modifications included, upon a royalty which is but a fraction of what camplainant claims to be the profit derived from it. Since January 9th, 1875, it has been open to them without royalty. They have been familiar with it throughout, and have been in competition with these defendants in the place where they are located, and their business has been on a scale that has put them in competition with other manufacturers throughout the country. They have continued, as well since the patent expired as before, to use their old process exclusively down to a date just before the witness was called to testify in this account; that is, 1883. About 1880 they purchased a digester for the purpose of trying the Tilghman process. They had then, to select from, all the "convenient vessels" developed down to that day. After making a trial they threw it aside and for three years the digester lay idle in their establishment, while their busines was carried on by the old method. After Tilghman had been in Cincinnati attending the evidence being taken on this account, the digester was re-organized to conform with the methods of defendants, including the use of a percentage of lime. It was done at just the time that would enable the witness to testify against his principal rival in business. This digester was used about a month before the witness was put upon the stand, but had been out of use for some days when he testified. He confesses to knowing very little about it, but expresses the opinion that it is valuable. Upon cross-examination it appears that a large proportion of their business continues to be done altogether in the old way, and that what is done with

this digester is usually finished by old methods, that is, that it does not do the work completely on any of the fat. This evidence, taken in connection with the circumstances of this manufacture has its weight in the opinion of the witness, a hot rival and competitor of the defendants, who seems to have made the experiments with reference to this case, and who is so unfamiliar with the details of it as not to be able to give any exact data, but its real import is in the exhibit which it makes of the business conduct of this rival through these many years of competition, signifying that the process, even in its improved form, had no such substantial value as to affect that competition, or to make it worth while for manufacturers, after they had been to the expense of putting in the apparatus, to do their manufacturing by it.

Manufacturers familiar with it, enterprising in their business, seeking every means of profit available to them, having it constantly thrust on their attention and in use by their competitors, when they were at liberty to use it, coupled with all modern improvements, without tribute or restriction of any kind, said, by their conduct that it was not profitable for them to do so.

In the presence of such evidence the claim that there was any large practical saving or advantage in using this process, as compared with other processes, becomes a purely speculative one, and speculation against evidence, against incontestable facts, against the history of transactions that have not been directed with any purpose of influencing the disposition of this controversy or of affecting the opinion of any Court as to the significance, the scope, or the value of this process.

Fifth. The results of the expert tests made during the controversy over the validity of the patent are in precise harmony with the verdict pronounced by the conduct of manufacturers, and, though held insufficient to defeat the patent, furnish strong corroborative evidence of its deficiency in commercial economy.

The tests made in the Mitchell factory, under all the conditions of the patent and with every advantage that mechanical and chemical skill and experience in the art could furnish, were witnessed by manufacturers using older processes, and in no wise affected by the controversy.

Thomas, a machinist and engineer, constructed the apparatus and testifies about it and the sharp smell of acroleine when it was operated (p. 234, *a.* 1–22).

J. F. Verdin describes the operation particularly (p. 241, *a.* 1; p. 242, *a.* 3). The exact means of preparing the emulsion specified in the patent, the welded pipe, and all the other details, were used. He says:

"Results were fat-acids, some undecomposed fat, glycerine in solution, and a sharp-smelling product called acroleine, which gave the fat and glycerine a very acrid smell and taste; the odor filled the whole building, which is about twenty-five feet square and forty feet high. It was very perceptible when you got to the rear of the building, so as to be felt in the eyes, irritating them."

Also, *a.* 8:

"Candles can be made from it, but they will not be of such good quality as those made at Mitchell's factory. The objection to it is its smell and not being well enough crystallized. This is owing to the smell arising from the destruction of glycerine. It is not the same as that which we are making, the difference being the want of thorough decomposition and the disagreeable odor.

Q. 9. Why was it not thoroughly decomposed, and how could it have been thoroughly decomposed, and what would have been the result to the glycerine?

A. It was not thoroughly decomposed, because the mixture of fat and water was not subjected to the heat long enough. It could be thoroughly decomposed either by increasing the time during which it is heated, or increasing the heat during the same time. The effect of either of these modes would be to destroy more of the glycerine."

This is the practical difficulty that was everywhere en-

countered. The moment the heat was carried to a point sufficient to effect thorough separation, a portion of the glycerine was decomposed, which was trebly disastrous, (1) because of the loss of glycerine, (2) because the resulting acroleine tainted the fat-acids, and (3) because the factory and vicinity were polluted by the offensive matter thus discharged.

He testifies to the superiority of the product got by the distillation process (*a.* 15–27).

Thain is an ex-candle-manufacturer, who was engaged in the business of candle-manufacturing ten years in Philadelphia and one year on Staten Island, and retired from the business two years before testifying; as competent and impartial a witness as could be had. He witnessed the tests of the Mitchell factory and describes them (p. 260, *a.* 1–13). He says that candles of the quality manufactured by Mitchell could not be made from the product of these experiments, because of the unpleasant smell, and that the difference in value would be five to ten cents per gallon on oil and two cents per pound on candles. He corroborates Verdin as to the superiority of the product of distillation.

Bower, a manufacturing chemist, whose business is to purchase and purify glycerine for sale, analyzed the specimens from the tests in Mitchell's factory, testifies that from the Tilghman process would not make a merchantable article of glycerine and could not be reduced and purified; that he would not pnrchase it if offered for sale; that it has a smell of acroleine, and that the sample from the distillation process is free from acroleine and of good quality. (p. 263, *a.* 8–14.)

Mitchell testifies (p. 414, *a.* 20) that:

"By subjecting fat to heat and pressure, as described in Mr. Tilghman's patent, the softer or more volatile portions of the fat are almost instantly decomposed into acids and glycerine; by continuing the heat long enough to decompose the harder portions of the fat the glycerine first formed is changed into acroleine, destroying the value of

all the glycerine and impairing that of the fat-acids, while, if a less heat is used the time would be too long to be practicable or profitable, without some means were used beside heat and pressure to bring and hold the water in contact with the fat, as stated in Mr. Tilghman's subsequent patent of 1860, which is based upon the principles of the Wright and Fouchè apparatus."

He states that after Tilghman produced testimony of the experiment made by his experts, he (Mitchell) requested permission to see the experiments repeated at any time convenient to complainant in the city of his residence, which request was refused, and that it was after this that he had made the apparatus for tests in his factory; that when this apparatus was completed, he gave notice to complainant and requested him to be present at its working which he declined to do (p. 415, *a.* 25-26).

After corroborating Verdin's testimony, he says (*a.* 27):

"We tried faithfully to produce the product claimed in Tilghman's patent, because, if fats could be decomposed into fat acids and glycerine in ten minutes, our process of ten hours, or sixty times as long, would be entirely worthless."

Florence Verdin testifies (p. 399, *a.* 16) to having made many experiments in many different vessels to get at the result that Tilghman claims, but says he could never produce good results under the heat specified in the patent. He decribes further experiments at the Ohio Candle Works, which he witnessed, in which a digester was used, and makes a computation from definite data as to the cost of operation as compared with the old lime process, showing the cost by the water process to be in excess of the old process (p. 399, *a.* 17-26).

Jones (p. 380, *a.* 6; p. 382, *a.* 15; p. 383, *a.* 21). This witness testifies to witnessing tests with the Tilghman apparatus at Shillito's factory and that—

"The product seemed to me to be a mixture of neutral

fat, fat acids, and acroleine, the fat acids strongly impregnated with the acroleine, dark and apparently unfit to make good candles."

And states that if he were obliged to use the water process without lime and without the pump in the digester, the cost of decomposing the fats would be too great to permit a continuance of the business.

Shillito (p. 388, *a.* 3) testifies to experiments with the Tilghman apparatus at his factory. He says:

"The fatty acids were imperfect and the glycerine destroyed."

Grant (p. 425, *a.* 25-35) testifies to witnessing the experiments at the Ohio Candle Factory, and says:

"The decomposition was very imperfect and the smell offensive. That material was totally unfit for the manufacture of candles in competition with any process."

Laboratory tests were also made by Professor Van Der Wyde, professor of chemistry in the New York Medical College, and in the Cooper Insitute, and by Professor Doremus, of the Belleville Medical Hospital and New York Free Academy, showing similar results. (*See Dep. Van Der Wyde, p.* 188, *a.* 4-12. *Dep. Doremus, p.* 215, *a.* 3-10.)

Sixth. The tests made in the progress of this account show why the process was unprofitable for manufacturing purposes and how far the efficiency of defendant's apparatus is attributable to modifications introduced since the patent, and confirm the experience of manufacturers and tests of former experts.

Extensive tests have been made both on a manufacturing scale and in the laboratory, for the purpose (1) of ascertaining whether more favorable results could be obtained than indicated by former tests, (2) of ascertaining wherein the practical difficulties lay, and (3) of determin-

ing how far the different modifications introduced since the Tilghman patent were severally instrumental in the process as used by defendants. That nothing might be wanted in the fairness of these tests an expert engineer was employed to superintend the mechanical parts, and there was associated with him the best practical mechanic available. President Morton, of the Stevens Institute of Technology, was employed to see that the chemical tests were thorough and exhaustive, and had associated with him Professors Endemann and Dudley in the same department. The practical work was done by men of skill and experience in the factory (*Dep. Gamble p.* 1339, *a.* 1–105). These tests were made with the certainty that if they lacked thoroughness in any particular, or if there was any inaccuracy of result, they would be confronted by rebutting evidence prepared under the supervision of the Tilghmans, who would be quick to detect any point of attack, and would repeat every test and analysis made if they doubted its correctness. They were made under every condition that could throw light upon the subject. They were repeated under different conditions as the progress of the evidence raised questions as to the result of this or that change. They have demonstrated the fact that the Tilghman process in any form of convenient vessel known to the art at the date of the patent, unless supplemented by some agency either mechanical or chemical not implied in the term "convenient vessel" and not suggested by the patents, would be quite incapable of competing with the old lime saponification, with the distillation process, or with the acidification process. They show that it is practically impossible to keep the hot fat any considerable length of time at just the temperature at which water without lime will effect the saponification, without crossing the line where acroleine is given off and the product ruined; that the practical result is, no matter how accurately the heat is regulated, that some of the fat will be imperfectly saponified, while at the same time some of the glycerine will be converted into acroleine, tainting

the product; that the mechanical difficulties are such as to exclude any method of external heat from being used with any continuity or on any considerable scale; that to apply the heat with any approach at evenness through the body of fat it must be enclosed in a slender coil of wrought iron bedded in cast iron; that, as the law of contraction and expansion of the two metals under intense heat does not correspond, fractures will result in the course of a few hours, if not before; that even when the coils will hold water at a pressure of nine or ten thousand pounds they will soon allow the hot fat to escape at a small fraction of that pressure; that the cup leathers will be acted upon by hot fat as they are not by hot water, and will be so rapidly destroyed as to require renewing every few hours; and that the average products when obtained and carefully analyzed are of so low a grade as to be unfitted for commercial purposes. They show that the small per cent. of lime is a factor of immense efficiency in the defendant's operation; that the forcing of the water in counter currents through the fat is a factor of such efficiency that its presence or absence represents a large percentage in the quality of result; and that the treatment with successive charges of water are also most important agents; all of these being agents introduced by subsequent patents. They show also that the percentage of fat-acid obtained by defendant's process, with all the improvements included, is less by a substantial percentage than that stated by complainant's evidence to have been obtained by the old lime saponification process. (*See dep. Hill, p.* 1295; *Manning, p.* 1327; *Morton, p.* 1355, 1388 *and p.* 1430; *Gamble, p.* 1339, 1424 *and p.* 1466; *Endemann, p.* 1250 *and* 1386; *Dudley, p.* 1334; *Procter, p.* 1331; *Donnelly, p.* 1372; *Pentland, p.* 1354; *Defendant's Ex., No.* 13, *p.* 1530; *No.* 14, *p.* 1531; *No.* 15 *and* 16, *p.* 1532.

As to the quality of pipe used and the pains taken to secure the best workmanship, *see particularly Dep. Hill, p.* 1296, *a.* 4; *Manning, p.* 1328, *a.* 17–21. A standard guage was used and the pipes stood the pressure of hot

water up to nine thousand pounds and were absolutely tight at that pressure (*p.* 1298), were several times tested to five thousand pounds and stood the test, but an hour or two of use with the hot fat practically destroyed them (*p.* 1298–1299).

As to the effect of high pressures on the cost of manufacturing *see Dep. Hill*, *p.* 1323, *a.* 19.

The precautions taken to accomplish in the most efficient manner each step, from the formation of the emulsion to the end of the operation; the repeated efforts made to overcome the mechanical difficulties; the impossibility of making the apparatus continue to work for any length of time; the greatly increased expense that would be incident to the use of this or any other apparatus under the degrees of temperature required where water was the sole agent; the liability of it to go to pieces at any moment, no matter how strongly constructed; the fact that, in practical operation, any degree of heat involving substantial pressure introduces many additional elements of expense; the extent of additional superintendence and special skill required where the conditions were so exacting and the danger of departure in either direction was so serious; and the fact that, expensive as this coil apparatus would be in practical operation, it would serve the purpose better than any other that could be used for such degrees of heat, appear clearly in Hill's testimony, answers 4 to 23, pages 296 to 310.

As to the thoroughness of the emulsion, the difficulties with the cup leathers, the character of the product, the impossibility of avoiding acroleine, and the tendency of the apparatus to rupture after short exposure, see further *Dep. Gamble*, 1342, *a.* 13; *Endemann*, *p.* 1251, *a.* 16; *Morton*, *p.* 1357, *a.* 9; *Dep. Dudley*, *p.* 1334, *a.* 3 *to* 8; *Manning*, 1328, *a.* 10 *to* 30.

This acroleine is admitted to have been given off by the tests made by complainant's expert, Booth (*Dep. Badgis p* 84, *a.* 7 to 11), and Booth admits that there were undistilled fats present in the products of his tests. While he thinks

that this would not be material, he made no test to determine it, and manufacturers skilled in the art unanimously pronounce the product not merchantable, or so inferior as to sell at a ruinous discount.

Gamble, though an interested party, has exhibited throughout a most conscientious, painstaking endeavor to get at the exact facts, with a disposition to give the complainant the benefit of every thing he was entitled to. No one can read his deposition without being satisfied that that he was scrupulously fair, and as competent to contribute every thing within the knowledge of a practical manufacturer and to judge of results as any man to be found. His judgment on the practical economy of this process is summed up as follows (p. 1343):

"*Q.* 19. Making no allowance for the extra wear and tear of machinery, or liability of breakage due to high pressure, or for the inferior quality of product, how much would it cost you to carry on the process of decomposing fats with the coil apparatus, as compared with the old mode of decomposition?

A. About ten times as much."

Hill says (p. 1322, *A.* 16):

"Considering the apparatus simply in a mechanical way, I believe that the several objections which I have noted are sufficient to defeat it for practical use."

Subsequent tests were made on a working scale, using the defendants' apparatus, but omitting, one after another, the several agents employed in defendants' manufactory but not suggested by complainant's patent. These tests and their results are described in *Dep. Gamble, p.* 142, *a.* 1 *to* 4; *Dep. Morton, p.* 1430, *a.* 188 *to* 191, and illustrated in defendants' Exhibit, No. 15, p. 1532. For instance, taking all the other conditions as defendants have used them, including defendants' digester, the mode of producing circulation obtained there, the steam introduced within the tank from a boiler connected with it, the water passing

back and forth through the steam, the perforated diaphram dividing the spray, as proposed by intervening patents, the successive changes of water claimed in Tilghman's 1860 patent, leaving out simply the one agency of one per cent. of lime, the table shows that the result in four hours is fifty-five and three-tenths per cent. of pure fat acid as against ninety-three per cent. in the same time where the lime is present.

Again. After the saponification is brought to ninety-three per cent., with all the other agencies present, including the lime, it remains substantially idle for some hours, until the introduction of a new charge of water, which immediately brings it up from a comparatively impure to a substantially pure product.

Again, as signifying the efficiency of the counter current of water through the fat produced by the pump, the first and second columns show that, where other conditions were the same, but in one instance the pump moved slowly and in the other rapidly, there was a result of forty per cent. obtained in the same length of time with the slow movement, and of seventy-five per cent. with the more rapid movement. These are sufficient to illustrate the fact that neither of these agencies are idle or immaterial. The absence of either might make the difference between a commercially available article and one commercially unavailable. In the aggregate they make the difference between a process that can maintain competition commercially and one which could not maintain such competition.

The only rebuttal of any of this evidence undertaken by complainant was through the deposition of Jones to show that the Perkins joint used in the coil apparatus (being the joints specified in the patent) were not properly constructed. He had not seen the joints and had never seen any operate under the conditions to which these were subjected. He expresses the opinion, that, constructed as he understands these to be, they would not be perfect Perkins joints. He says that such joints as these would be certain

to leak under 2,000 pounds pressure, and he doubts if the Perkins joint would stand that (p. 1486, *a.* 29-30).

Now as the joints used by Hill are shown to have stood without leaking a pressure of 9,000 pounds when tested with hot water, it is clear that they were much more perfect than this expert understood the ordinary Perkins joint to be. The same witness testifies that lifting jacks which use cup-leathers are sometimes left out-doors, where, in some instances, they would be liable to encounter the heat of the sun up to a temperature of 110 degrees, and he has not known of the cup leathers being injured by such exposure.

This seems to be offered to rebut the testimony of Hill that his cup-leathers, when in contact with hot grease at that temperature, while in operation, speedily gave way. It does not appear that Jones ever examined the cup-leather of a jack that had been for a momont exposed to a sun of this temperature. If such a jack happened to be so exposed, it is hardly probable that the cup-leather would be heated to that temperature. If it were, the conditions presented when heated grease operated upon it at that temperature would be wanting; and if it was found afterwards to be inoperative, that fact would hardly be thought of as traceable to such exposure. It was very easy to show the incorrectness of Hill's testimony by a test under the same conditions, if such tests had proved it incorrectly. It is quite certain that no such evidence could be had.

Another criticism that has been urged in the argument of counsel against the tests made by defendants was that the fat was only *exposed* to the temperature named for ten minutes, and that no allowance was made for the time consumed in raising it to that temperature, it being insisted that the time specified in the patent was the time the fat should *possess that temperature* rather than the time it was exposed to it. This illustrates well how ingenious complainant can be in reading out of his own patent a significance that it was never intended to have. The language of the patent and the tests suggested show plainly that

ten minutes is given as the time of exposure to this temperature, not as the time which the fat possesses this temperature. Indeed, if it was intended to prescribe the temperature which the fat should possess for the ten minutes it would be doubly absurd. The only test possible would be of the temperature to which the fat was exposed, and when exposed for a short time to a high temperature, it would not possess the same temperature for any substantial period, but would be rising in temperature until discharged. That the interpretation given the patent by the patentee and by his own experts was the same as that assumed by the defendants in these tests, and the reverse of that for which the complainant now contends, is abundantly shown.

Tilghman himself says in describing the operation of his patent, speaking of the fat (p. 1160, *a.* 16):

"It *traverses* in ten minutes and must be *exposed* to the desired heat for ten minutes."

"And again:

"Its whole capacity will be utilized by the mixture, which must *remain* in it the specified time, *be exposed* in it to the specified heat and become well decomposed."

So his expert, Professor Booth, in referring to his tests, which were represented to be in exact accord with the patent, says (p. 51, *a.* 11):

"Such a charge would *remain* in the coil about ten minutes at a time."

After this, a deliberate attack by this complainant upon defendants' tests, because they understood the ten minutes to be the time of *exposure*, the time of *traversing*, the time of *remaining* in the coil, illustrates how much easier it is to construe the patent to meet the exigencies of the case, than it was to find apparatus to meet the exegencies of the patent, and how much easier it is to criticise than to rebut defendant's testimony.

Seventh. The complainant, by failing to furnish evidence of mechanical results actually obtained in any working of the process, has conceded that favorable evidence of this character was impossible.

During the entire progress of this controversy, and especially since the question of actual commercial economy arose on this account, it would have been of immense importance to complainant to demonstrate, by operations on a manufacturing scale, the operative economy of this apparatus, as worked either by the coil apparatus or by some other "convenient vessel" available in the art at the date of this patent, if such demonstration would show results approximating what he claims. He has saved no expense in other directions. Expensive experts have been employed in great numbers; eminent counsel have represented him at every point; but with strong incentives to make such demonstrations, if they would at all realize his claims, he has either carefully avoided them, or withheld them from evidence.

No discreet manufacturer would think of calculating actual commercial profits upon data furnished by laboratory experiments. It is a matter of daily observation that such data are grossly misleading as a basis of estimating the relative profits of business enterprises. The elements introduced where the nice adjustment of conditions available in the laboratory, the skill of the expert chemist, and the smaller bulks treated, are exchanged for the exigencies of the factory, the coarser labor necessarily employed there, and the larger bulks to be operated upon, are apt to much more than off-set any theoretical saving. The relative liability to miscarriage, the relative skill and attention required to preserve the conditions essential to successful operation, the relative strain on machinery and hazards to property and life, and many other factors, concerning which the laboratory tests are silent, enter into the mechanical problem, and their measure can only be ascertained by commercial results actually obtained under com-

mercial conditions. If, as appears as well from complainant's as defendents' evidence, a slight excess of heat or a slight prolongation of the exposure may produce acroleine and so ruin the products, and a slight deficiency in either may leave the material but partially saponified, and so unfitted for use; it might be quite possible to get a satisfactory result in the laboratory, when the losses which would result from the inevitable variations in these respects incident to manufacturing, and the difficulty of uniform exposure throughout the bulk to be treated, would more than eat up the theoretical profits. The intimate emulsion required might be obtainable in the one instance, and yet practically unobtainable with the necessary uniformity in the other. Abundant illustrations of the mechanical difficulties liable to enter as disturbing elements are found in the depositions of Hill, Manning, Gamble, Morton and others, heretofore cited. No measure of recovery could be more worthy the term speculative than one based on estimates of profits that are not shown to be actually realized under the conditions of commercial manufacturing.

Eighth. If estimates of the character made in behalf of complainant were otherwise to be entertained as a measure of recovery, they must be rejected, because contrary to evidence.

The calculation of saving of glycerine assumes, contrary to fact, and without evidence to support it, that glycerine was not obtained by the old process, whereas it appears that it was obtained but allowed to run to waste; that the uses to which it is now put and which afford its principal market had not been discovered—such, for instance, as the dilution of wines, beer and liquors, the manufacture of nitroglycerine, dynamite and other explosives, the sweetening of tobacco, the flavoring and preserving of meats and fruits, and various other manufacturing and commercial purposes. The invention of an efficient mode of purifying it by Wilson & Payne, in 1855, had far more to do with making it available than any change in the art of producing it. (*See Shoemaker paper, p.* 1514; *Wilson Lecture, p.* 123; *Dep. Endemann, p.* 1264, *a.* 86 *and* 88;

Morton, p. 1376, *a.* 42–43; *and Wilson & Payne patent, p.* 1550.)

The saponification by the old lime process consisted in the separation of the fat-acid from the glycerine, the divorcement of these two components of fat constituting the process of decomposition. The two products of it were fat-acid and glycerine. The defendants used an excess of lime and of sulphuric acid, sufficient to effect a complete separation of these two elements, and to further disentangle them from the lime and sulphuric acid respectively. The evidence shows that there was a thorough saponification. Complainant proposes to charge them for this excess of lime and acid, and then charge them for the entire glycerine which this is shown to be more than adequate to completely separate.

Complainant has not shown one ounce more glycerine to be yielded by defendants' process, with all its improvements, than was obtained by the old lime process. He is not entitled to credit for the value imparted to it by the process of distillation invented after the patent.

The defendants' glycerine has to be subjected to the same treatment to separate it from the lime as that from the old process. (*See Dep. Endemann, p.* 1208, *a.* 102; *Dep. Morton, p.* 1375, *a.* 38–42.)

The computation by which it is charged defendants have saved the cost of reducing glycerine from ¾° B. to 3¼° B. is unfounded, for two reasons: first, that defendants were paid for their labor and cost in reducing glycerine, and therefore, at worst, lost nothing by doing so; and, second, that complainant has furnished no data to even approximate the cost of reducing from ¾° B. to 3¼° B., the cost of reducing in higher degrees being altogether out of proportion to that of reducing in the lower degrees, and furnishing no evidence of the latter. What Gamble states, in testimony, is the average, for the period named, of the amount they were paid for concentrating glycerine from 3¼° to 15°, not the average price per degree.

So, too, in the computation of saving of labor, complainant selects arbitrarily some items from Mr. Verdin's estimates, rejecting others, and some items from Mr. Gamble's to offset against them. If he is to adopt Verdin's figures in part, he should adopt his tables through this particular estimate—which would give the old lime process a saving as compared with Tilghman, when the latter is used, with most of the later modifications.

He neglects the fact that Mr. Gamble's two consecutive answers (21 and 22, p. 229), taken together, show that night work as well as day work is required, 132 hours of work being counted for the week instead of six days of working hours, and makes his calculations on day work only. It is not shown what the amount of cost of such work was in Procter & Gamble's factory when they used the old process, and no basis is laid for comparison. In respect to fuel, too, Mr. Gamble's estimate for heating the digester alone is assumed to represent the entire cost of fuel for the complete process, including preparation of fat before, and neutralization after, digestion, when it is expressly limited to heating the digester.

A claim has been made for a saving of fat-acids on the theory that by the Tilghman process ninety-seven per cent in quantity would be obtained. The entire amount of fat-acid in pure tallow does not exceed about 95.5 per cent (*Dep. Morton*, 1374, *a.* 33; *Endeman p.* 1258, *a.* 42). Complainant claims that the Tilghman process yields 97.5 per cent; that is, two per cent in excess of what exists in the fat. This is manifestly impossible. There has never been an exact analysis of the fat where they claim this percentage to have been yielded, and it is evident that if they got in quantity 97 per cent of the material treated, it was not pure fat-acids, but a percentage of foreign matter, which would be an injury, not a benefit.

An extract from Berthelot (p. 1553) was cited by complainant as if recognizing the possibility of getting by the Wright & Fouchè process 97.5 per cent. The extract shows plainly that it is the *quality*, not the *quantity* of fat-

acid obtained by these experiments that the author is considering; it is 97.5 per cent in *quality*, not 97.5 per cent of the amount of fat treated that is referred to. No such extraordinary theory is advanced as that 2 per cent more than the theoretical amount of fat-acid can be got out of the fat. If the author had encountered a phenomena so paradoxical as getting out of tallow more fat-acid than there was in its composition, it would not have been passed without some comment upon so remarkable an inconsistency. But irrespective of this evidence, the actual test shows that defendants obtained considerably less than the 95 per cent conceded to be yielded by the old lime process. If the Tilghman process takes up impurities to be passed off as fat-acid, the complainant has not got the benefit of that peculiarity. The evidence shows, without contradiction, that the percentage obtained by defendants when operating their process as operated during the term of infringement did not exceed 92.5 per cent, making a substantial loss in this product as compared with what complainant accords to the lime saponification process. (*See Dep. J. N. Gamble*, *p.* 1344, *a.* 13.)

James Gamble (p. 1217, *a.* 4–9) testifies that they made glycerine when using the old lime saponification process, but allowed it to run to waste because they knew no use for it. They continued to waste it after they began to use the close tank until a man came along who said he could save it (see also p. 1218, *a.* 13–15).

Stress has been laid on the fact that Mitchell obtained a higher price for his products than other manufacturers. If this were due to the absence of lime from his process, it would lay no foundation for account here because he obtained the same advantage over those using defendants' process as those using other processes. But the reason for his obtaining it is explained by the fact that he practiced double pressing, which, while considerably increasing the cost of production, increases the quality of product. (*Dep. Procter*, *p.* 1531, *a.* 3–18.)

The judgment pronounced upon the practical econ-

omy of the Tilghman process by the jury of the Industrial Exposition of France in 1855, after witnessing its operation for the purpose of reporting its industrial value, has been singularly confirmed by the experience of all who have undertaken to apply it to commercial uses during the succeeding thirty years. After seeing it applied to the most favorable material, palm oil, which dissolves much more readily than the fats used by defendants, they report officially (p. 1038):

"We are sorry to say that the fatty matter, on coming out of the apparatus, was not all deodorized; and, more besides than that, that it gave out a strong odor of acroleine. From the point of view of the quality of the products, this arrangement of apparatus then by no means realized the end which the author has proposed. Moreover, in any kind which works constantly at a temperature capable of exerting a pressure of ninety to one hundred atmospheres, are such that it is hardly probable that industry will utilize it, even if the products which it furnished were irreproachable."

If the economic objections to this process were capable of solution, the modifications by which that solution was to be accomplished were no more obvious to these scientific experts than they were to the manufacturers or to Tilghman himself.

Respectfully,

ROBERT H. PARKINSON,
Of Counsel for Defendants.

WILLIAM M. RAMSAY,
Of Counsel.

IN THE

U. S. SUPREME COURT.

No. 25.

R. A. TILGHMAN, APPELLANT,

vs.

PROCTOR, *et al*, APPELLEES.

STATEMENT OF CASE, BRIEF AND ARGUMENT FOR APPELLANT.

GEORGE HARDING,

Counsel for Appellant.

PHILADELPHIA:
PRESS OF EDWARD STERN & CO.
125-127 North Seventh Street.

IN THE

U. S. SUPREME COURT.

No. 25.

R. A. TILGHMAN, APPELLANT,

vs.

PROCTOR, *et al*, APPELLEES.

STATEMENT OF CASE, BRIEF AND ARGUMENT FOR APPELLANT.

GEORGE HARDING,

Counsel for Appellant.

In the Supreme Court of the United States.

RICHARD A. TILGHMAN, Appellant,

vs.

PROCTER, *et al.*, Appellees.

No. 25.

APPELLANT'S STATEMENT OF CASE.

This is a suit brought by R. A. Tilghman (the appellant), who is the owner and patentee of Letters Patent No. 11,766, describing and claiming a new process for obtaining free fat acids and glycerine from fatty bodies.

The appellees, who are charged in the bill with the infringement of the extended term of said patent, were for many years the licensees of Tilghman, and paid him large sums as royalty on the product of what they conceded to be the same process as that complained of. Since the 1st of May, 1870, appellees have made no payment of royalty, and shortly afterwards their license was revoked by appellant in the manner in said license contemplated and provided.

The present action was begun shortly afterwards and the appellees, as a defence, allege the invalidity of the patent, and also deny that they infringe the same.

The record in this case is made up in great part of the Supreme Court record in the case of Mitchell *vs.* Tilghman reported by Wallace), vol. 19, p. 287, introduced by stipulation of counsel.

[Record pp. 24 and 25.]

This is supplemented on the part of appellant by his own testimony on certain points, which it is considered were not made suf-

ficiently clear to the Court in the former suit, and certain additional exhibits going to prove the absolute novelty of appellants invention. The only addition to appellees' testimony is a table showing the requisite thickness of iron to withstand a certain pressure, the same being calculated for boilers of varying diameter.

The case having been argued in the Court below, an order was entered dismissing the bill. From this the appellant appealed, assigning for error the action of the Court in dismissing the bill.

ABSTRACT OF PLEADINGS.

BILL OF COMPLAINT.

1. Sets forth grant of Letters Patent to R. A. Tilghman, appellant, for fourteen years from January 9th, 1854.

2. Adjudications under said patent in the United States Circuit Courts for the Southern Districts of Ohio and of New York.

3. The extension of said Letters Patent for seven years from the 9th of January, 1868.

4. An adjudication under said extended Letters Patent in the United States Circuit Court for the Southern District of Ohio.

5. A contract between the defendant firm and the complainant, entered into about February 24th, 1865, in accordance with which a large sum was paid by appellees for past infringements, and they continued to manufacture under a royalty.

6. A renewal of the contract of license under the extended term, and payment of royalty up to the 1st of May, 1870.

7. The refusal of the appellees to pay royalty after May 1st, 1870, and the revocation and termination of the license.

8. The reduction of the patented improvement to use.

9. The infringment of appellees.

ANSWER.

1. Admits the granting of Letters Patent.

2. Alleges that English Letters Patent, of the date of January 9th, 1854, were granted appellant, and that appellant's patent is therefore null and void.

3. Alleges that the appellant having filed his application August 6th, 1854, the Commissioner of Patents exceeded his power and

jurisdiction in antedating said patent as of January 9th, 1854, and that said patent is therefore null and void.

4. Admits the extension of Letters Patent.

5. Alleges that if the original Letters Patent are not from improper dating, *ipse facto*, null and void, they should be construed to be for fourteen years from date of issue, viz., October 3d, 1854, and that the extension is therefore null and void.

6. Admits the adjudications alleged in the bill.

7. Alleges the appeal of the case against Mitchell to the Supreme Court of the United States, and that the record in the suit against Werk, *et al.*, was by stipulation incorporated in the Supreme Court record in the said appeal.

8. Alleges that by a decision of said Court rendered March, 1874, the decree in said appealed case, was reversed with costs, also the petition of the appellee, the present appellant for a rehearing and its refusal by the Court.

9. Alleges that prior to the appellant's invention, it was well known that fats could be decomposed by heat of the degree specified, and that no new chemical fact was discovered by Appellant, who merely used water as a vehicle to convey the heat and provide means of hydrating the oxide of glycerine, and that it was not known to the patentee that heated water would decompose fat at any less temperature.

10. Denies that they have at any time since January 9th, 1868, or are, using the appellant's process, or any process substantially the same.

11. Alleges that the process used by appellees since January 9th, 1868, consists in placing in a strong copper lined iron tank, a mixture of equal parts of fat and water together, with a quantity of lime equal to about one per cent. of the fat used, the fat and water are kept in admixture by means of a pump drawing the liquid from the bottom and throwing it upon the top of the fluid mass, and the requisite heat and pressure are obtained by introducing superheated steam at a constant pressure of from 200 to 250 pounds to the square inch, at the top of the digester. This heat and pressure are maintained from nine to ten hours before the process is complete.

12. Alleges that the normal working pressure of appellees' apparatus is from 200 to 250 pounds, and that it is incapable of re-

sisting a pressure within 1,500 pounds of that described in the patent, as the normal working pressuse of the apparatus spoken of.

13. Denies that appellees have ever used appellant's process, and alleges that they took a license thereunder, under a misapprehension of the facts, and by reason of untrue representation of appellant as to the scope of his patent.

14. Denies that appellant has reduced his invention to practical use, and alleges that he was ever engaged in the business to which the patent relates, and that, the only attempt to put in practice the patented process, resulted in its failure and abandonment.

15. Alleges that the process patented by appellant is wholly useless, by reason of the fact, that any apparatus sufficiently strong to withstand the specified pressure, must necessarily be of such contracted dimensions as to make impossible the productions of a commercially considerable product.

16. Cites (see Record pp. 21 to 23), numerous prior patents and publications as anticipating appellant's invention, see Exhibits 1 to 20, Record pp. 246 to 259.

CLASSIFICATION OF PRIOR REFERENCE AS TO NOVELTY.

1st. Extracts showing use of digesters, such as Papin's, for general purposes. (This contains merely general references to use of close vessels for heating water to high temperature, and still retaining it in a liquid state).

Exhibit No. 14, Record, p. 254.

2nd. Extracts showing use of digesters for rendering raw fat or removing the membraneous and cellular matter, and thus purifying it.

Manicler's Patent, Exhibit 15, Record p. 255.

3rd. Extracts from text books and writers, stating that neutral fats can be decomposed into fat acids and glycerine, and that in the act of decomposition the elements of the water are taken up by the fat acids and glycerine.

Dumas' Chemistry, Exhibit No. 7 Record p. 250.

Philosophical Maga. Exhibit No. 5, Record p. 249.

Dumas' Chemistry, Exhibit No. 6, Record p. 249.

Dumas' Chemistry, Exhibit No. 3, Record p. 247.

Thenard's Chemistry, Exhibit No. 2, Record p. 247.

Berzelius' Chemistry, Exhibit No. 11, Record p. 252.

Berthelot's Ann. de Chimie, Exhibit No. 16, Record p. 255.

Pelouze and Fremy's Chemistry, Exhibit No. 19, Record p. 259.

4th. Extracts to show that alkaline saponification decomposes neutral fat into soap and glycerine, which soap can afterwards be decomposed into fat acids; and, also, to show that the alkaline saponification can be better effected in a close vessel under pressure.

Chevreul's Patent, Exhibit 18, Record p. 258.

Dumas' Chemistry, Exhibits 3 & 7, supra.

Thenard's Chemistry, Exhibit 1, Record p. 246.

Enclyclopedie Roret, 1849, Record, p. 474.

5th. Extracts stating that fats can be distilled in the presence of steam into fat acids, which are passed over as vapors and condensed in the still.

Dubrunfaut's Patent (1841), Exhibit 4, Record p. 247.

Scharling's Essay, Exhibit 10, Record p. 251.

Regnault's Chemistry, Exhibit 20, Record p, 259.

Pelouze and Fremy's Chemistry, Exhibit 19, Record p. 259.

Payen, Record p. 474. See Record p. 474.

6th. Extracts to show use of highly heated water to decompose fats, but of a date subsequent to appellant's patent.

Berthelot's Ann. de Chimie (1854), Exhibit 16, Record p. 255.

Berthelot's Academy Report (1854), Exhibit 17, Record p. 258.

7th. Notice of certain changes in fat which occurred in Perkin's engine in 1823, published in London Querterly Journal, 1823. Exhibits C, D and E. Record p. 393, Perkin's patent.

8th. Article on change in castor oil, noticed on surface of cistern of a water barometer, published in Transactions of Royal Society, 1832. Exhibit F, Record p. 398.

9th. Refers to Appert's patent.

APPELLANT'S POINTS.

I.

Appellant was the discoverer of the chemical fact that fatty or oily substances would be decomposed and the fat acids and glycerine separated by the action of water at a high temperature and under pressure, and was the first to describe a process by which his said discovery could be utilized in the arts, viz.:

The heating of fatty matter and water in proper proportions in a closed vessel of sufficient strength to prevent the evaporation of the super-heated water.

Having thus described the mechanical means of carrying into effect his discovery, he is entitled to protection whatever be the form of the closed receptacle or the means of heating it.

O'Reilly *vs.* Morse, 15 Howard 62.

Neilson *vs.* Harford.

Househill Co., *vs.* Neilson, 1 Webs. Pat. Cas. 687.

Corning *vs.* Burden, 15 Howard 267.

See Patent (Record, pp. 8 & 10).

TILGHMAN'S ACCOUNT OF EXPERIMENTS MADE IN DEVELOPING HIS INVENTION.

(Record pp. 1008–1012.)

TILGHMAN NOT ANTICIPATED BY CHEVREUL.

a.—Admitted by Appellees' witnesses.

Dr. Smith, pp. (796, Q. 7, & 820, Q. 119.)

Van der Weyde, p. (176, Q. 78.)

b.—Testimony of Appellant's witnesses.

Prof. Booth, p. (52), Prof. Genth, p. (89, Q. 9), Booth again at p. (609), Rogers, p. (676, Q. 48.)

TILGHMAN NOT ANTICIPATED BY SULPHURIC ACID DISTILLATION.

Journal of Society of Arts, Wilson's paper, Record, p. 106.

Testimony of Appellees' witnesses showing that by this process the glycerine was destroyed.

Dr. Smith, p. (796, Q. 7), Verdin, Sr., p. (157, Q. 9.)
J. H. Smith, p. (233, Q. 2.)
Wayne, p. (863, Q. 156), Verdin, Jr., p. (226, xQ. 168.)

TILGHMAN NOT ANTICIPATED BY STEAM DISTILLATION PROCESS.

1st. Because it was an unsuccessful and abandoned experiment.

Wayne, p. (55, Q. 108), Verdin, Sr., p. (161, xQ. 56), Verdin, Jr., p. (216, xQ. 60), Appellees' Exh. 10 (Record, p. 251), Verdin, Jr., p. (225, xQ. 157), Rogers, p. (79), Appellants' Ex. 1000.

2d. Even if it had been successful it differed entirely from Tilghman's process.

(*a.*) Because it produced no glycerine.

(*b.*) It did not allow or permit of the presence of super-heated water.

(*c.*) It was a process of vaporization and condensation of the fat.

(*d.*) The apparatus necessary was such as could not be used in the super-heated water process of Tilghman.

Dr. Smith, p. (832, Q. 194–5), Wayne, p. (852, Qs. 84–6). Booth, p. (600, Q. 92), Booth, p. (606, Q. 124), Verdin, Jr., p. (216, xQs. 28 & 30), also pp. (155–6, xQs. 282 & 285), Gibbs, p. (28, Q. 14), Jury report of Exposition Universelle de 1855, pp. 495–6, preceding appellees' Exhibit (Record, p. 910), Wilson's Lecture, (Record, p. 113), Smith, p. (237, xQs. 68–72.)

NOT ANTICIPATED BY APPELLEES' EXHIBITS, pp. 393–9—(DESCRIPTIVE OF PERKIN'S SCUM.)

The Exhibits do not pretend to describe any process for making fat acids and glycerine. Glycerine is nowhere alluded to, and the description of the "*changed*" fat shows that *it was not changed to fat acids.*

Appellees' Exhibit E., p. (397), (Perkin's scum), admitted by Appellees' witnesses not to describe fat acids.

Dr. Smith, p. (821, Qs. 124 & 124½.) Wayne, p. (865, Qs.

169–173), Mitchell, pp. (761, Qs. 83–5; 762, Qs. 97–8; 768, Qs 134–5.) Verdin, Sr., p. (789, Qs. 109–13.) Dr. Smith, p. (821, Qs, 123–7), Wayne, p. (864, Q. 165.)

Appellant's experts state positively that the Perkins' scum was not fat acid.

Professor Booth, p. (593, Qs. 64–5), Professor Rogers, p. (675, Q. 40.)

Perkins' scum was really Lime Soap.

Professor Rogers, p. (677, Qs. 43–45), Dr. Smith, p. (822, Qs. 131–3), Mitchell, p. (749, Q. 17), p. (749, Q. 20), pp. (766–7, Qs. 122–126), Dr. Smith, p. (822, Qs. 128–130), Rand, p. (906, Q. 143), Matthewson, p. (738.)

TILGHMAN NOT ANTICIPATED BY MANACLER'S PROCESS.

Exhibit p. (255), Manacler states nine times that his product is not fat acids and glycerine, but tallow. See on this *exhibit* Van der Weyde, p. (180, Q. 108), Gibbs, p. (29, Qs. 37–8), Van der Weyde, p. (184, Q. 134), Booth, p. (51), Genth, p. (89.)

Manacler's process was a mere rendering process, so also was Wilson's.

Verdin, p. (242, xQ. 19), Jones, p. (34, Q. 13.)

THAT APPELLANT WAS THE FIRST TO ANNOUNCE THE SCIENTIFIC FACT THAT FATS COULD BE DECOMPOSED BY SUPER-HEATED WATER INTO FAT ACIDS AND GLYCERINE IS

a.—Admitted by Appellee's Witnesses.

Mitchell, Record, p. (763), F. Verdin, Record, p. (242), J. T. Verdin, p. (216), Van der Weyde, Record, p. (185), Dr. Smith, Record, p. (832), Wayne, Record, p. (860), Grant, Record, p. (925.)

b.—Proved by Appellant's Witnesses.

Booth, Record p. (609, Qs. 587–8), Rogers, Record, p. (632), Genth, Record, p. (86–7), Bridges, Record, p. (72), Gibbs, Record, p. (31), Booth, Record p. (56), Gibbs, Record, p. (30), Booth, Record, p. (52), Genth, Record, p. (87.)

RECOGNITION OF TILGHMAN AS THE DISCOVERER OF THE SUPER-HEATED WATER PROCESS OF DECOMPOSING FATS, MADE PRIOR TO OR OUTSIDE OF ALL LITIGATION.

Wilson, Record, p. (112), Graham, Record, p. (1018), Hale, Record, p. (1035), Meyer, Record, p. (1036), Patent Office, Record, p. (435–6), Jury Report 1855, Record, p. (743, also p. 910), Report of Juries 1862, Record, p. (743–4), Wilson's patent, p. (113), Watt, Record, p. (279), Muspratt, Record, p. (279), Richardson and Watt, Record, p. (278.)

LEAD MELTING HEAT ALONE, WITHOUT MOISTURE, INCAPABLE OF DECOMPOSING FATS UNDER PRESSURE.

Debrunfaut's patents (Ex. 4, Record, p. 248.) Tilghman's Caveat (Record, 1034.) Tilghman, p. (1014, Q. 12.)

II.

Appellant's patent is for a process and is patentable, and not for a mere philosophical principle unapplied to practical use.

O'Reilly *vs.* Morse, 15 How., 62.

Household Co. *vs.* Neilson, Webster, Pat. cases, 687.

Corning *vs.* Burden, 15 How., 267.

See Patent, (Record, pp. 8–10.)

III.

The mention of the use of a "convenient vessel" in appellant's patent, is sufficient without further description or reference to known existing apparatus.

Household Co. *vs.* Neilson, 1 Webster Pat. cases, 687.

Emerson *vs.* Hogg, 2 Blatchford, 9.

Brooks *vs.* Jenkins, 3 McLean, 447.

S. P. Kneass *vs.* Schuylkill, 4, Wash., 13.

See Patent (Record p. 8.)

KNOWN MACHINES IN USE IN THE ARTS.

See Booth (Record p. 266.)

Tilghman's evidence as to experiments with simple digesters (Record 1008–13.)

IV.

Appellees infringe by the use of highly heated water under pressure to decompose fat into fat acids and glycerine. Appellant's patent is not limited to specific degrees of temperature.

Mowry *vs.* Whitney, 15 Wallace, 636.

Goodyear *vs.* Wait, 3 Fisher, 248.

American Wood-Paper Co. *vs.* Glen Falls Co., 4 Fisher, 328.

Patent (Record pp. 8–10.)

Tilghman's evidence as to apparatus and temperatures used in experiments made before application, and reasons for preferring high temperature (Record pp. 1008–1012.)

Absence of steam only prescribed for continuous apparatus (p. 8–9.) Tilghman (1016, Qs. 15–16.)

STEAM.

(a) Steam Not Essential to Appellee's Process.

Mitchell p. (775–6), Smith, p. (810, xQ 58), Rand, p. (885, xQ 30.)

(b.) Steam Alone Inoperative.

Verdin, p. (242, Q. 12), Wilson's process, Jones, p. (34, Q. 12), Walther's process, (R. p. 576), Booth, p. (608, Q. 134), Grant, p. (95, Qs. 39–42.)

IDENTITY OF APPELLEE'S AND PATENTED PROCESS.

Booth, p. (43, Q.6), Bridges, p. (72, Q. 5), Genth, p. (86, Q. 3), Gibbs, p. (20, Q. 3)

SUPER-HEATED WATER ESSENTIAL TO APPELLEE'S PROCESS.

Wayne, p. (860, xQs. 136–7.)

STEAM DISTILLATION A MERE CHEMICAL CURIOSITY.

Booth by super-heated water decomposed animal fats in five minutes, p. (588, Q. 30), Wilson required 24 to 36 hours to decompose palm oil. See jury report (preceding Exhibit on p. (910), and his product was unfit for candles, Tilghman, p. (1029, Q. 59.)

V.

Appellees infringe none the less because they insert a small per-cent. of lime in their digesters. Two processes then go on independent of each other, *i.e.*, the old lime saponification process, producing lime soap, and the infringing process producing free fat acids and glycerine by the use of super-heated water alone.

Patent, p. 10.

TILGHMAN'S EXPERIMENTS WITH LIME, ITS USE A MISTAKE.

(R. p. 1013.)

IF LIME IS USED IN LARGE QUANTITY, THEN TWO INDEPENDENT PROCESSES GO ON TOGETHER.

Booth, p. (442 & 53, Q. 53), Ropes, p, (120), Report of jury London Exhibition of 1862, pp. (743–4), Rand, p. (891.)

USE OF LIME IN ANY EVENT A MERE MODIFICATION OF APPELLANT'S PROCESS.

Rand, p. (891), Verdin, p. (781, Q. 25), Booth, p. (588, Q. 36), Smith, p. (829, Qs. 171–3), Wayne, p. (863, Q. 153), Rand, p. (889, xQs. 59–60), Wayne, pp. (846 & 864), Mitchell, p. (753, Q. 42), Rand, p. (896–7.)

The above references are to the point that the hastening action of lime is simply a consequence of the formation of an emulsion, and that it must stand on the same footing as the use of any other mixing device.

USE OF LIME TO THE EXTENT OF APPELLEES' USE REFERRED TO IN PATENT.

Record, (pp. 10 & 1013.)

VI.

The mere suggestions of actual and possible modes of operation in prior books or patents, is not sufficient to invalidate a patent for a process reduced to practice and adequately described.

Curtis on Patents, §378.

Bettz *vs.* Menzies, 7 Law Times, N. S. 110.

Household Co. *vs.* Neilson, 1 Webster Pat. cases, 690.

VII.

Appellant's patent is not void for want of practical utility, or because lower temperatures are generally used than those pointed out in appellant's patent, or because there may be inconvenience in working his process at the maximum temperature mentioned by him.

Mowry *vs.* Whitney, 14 Wallace, p. 646.

Patent, (R. p. 8–10.)

Tilghman's evidence as to experiments, (Record, pp. 1008– .)

INTRODUCTION INTO USE.

a.—Coil Apparatus was First Introduced.

Wilson's letter, (R. p. 112), Graham's letter, (R. p. 1018), Hale and Meyer's letters, (R. pp. 1035–6), Tilghman, (R. pp. 1014– , Q, 13), Booth, (R. pp. 610–11, & 614), Rogers (R. pp. 673, Qs. 32–3). Bridges, (R. pp. 72), Nason, (R. pp. 65– , Qs. 5–7.)

b.—Convenient Vessels were afterward used by Tilghman.

(R. p. 415), Letter, (p. 740), Use of appellees'. See further (R. p. 929.)

PRACTICAL CHARACTER OF TILGHMAN'S PROCESS IN BOTH FORMS OF APPARATUS.

(*a.*) *Simple digester proved to work his process successfully at temperatures from 612° F. to 320° F.*

Prof. Booth, p. (588, Q. 36.) Same witness, p. (613, Q. 149.) Tilghman, p. (1008, Q. 2.)

(*b.*) *Practibility of Tilghman's continuous apparatus. It is recommended but not claimed by Tilghman.*

Wilson's lecture, p. (113), Tilghman, p. (1014, Q. 13), Exhibit Graham, p. (1018), Exhibit Hale. p. (1035), Exhibit Meyer, p. (1036), Tilghman, p. (91), Booth, pp. (610-61, Qs. 139, 140), Rodgers, p. (973, Qs. 32, 33), Booth, p. (614, Qs. 132, 133.)

MONIER'S EVIDENCE IS REFUTED BY ABOVE AND APPELLEES' WITNESSES.

See Mitchell's partner, Verdin, p. (77, Q. 5), also p. (785, xQs. 69–73), and pp. (784 to 785, Qs. 55–56 and 61); on this matter see Tilghman's new evidence, pp. 1009, 1010, 1011, Q. 7), also letters, pp. (280–281), and contract, pp. (1036–1037.)

(*c.*) *Continuous coil apparatus safer than boiler form.*

Table, p. (25), Nason, p. (65, Qs. 5–7), Tilghman, p. (1009, Q. 4–6.)

(*d.*) *And capable of giving as large and larger products.*

Tilghman, p. (1015, Q. 14.)

VIII.

The extension is valid on its face. Its validity cannot be impeached in this suit,

ARGUMENT FOR APPELLANT.

Prior to the invention of Tilghman, it was known that neutral fats could be decomposed into fat acids and glycerine, and that, in the act of decomposition, these products absorbed the elements of water into their constitution. To effect this chemical decomposition of fats, two modes were attempted or practiced, viz: alkaline saponification and distillation. The former produced lime soap and glycerine, the latter (prior to Tilghman's invention,) produced fat acids but did not produce glycerine as a result. This subject is fully discussed on page , post.

Tilghman's invention was of a "manufacture" or an "improvement in manufacture" of fatty acids *and* glycerine, that is, the manufacture of old things in a new way. It was therefore directly within the words of the Act of Congress, authorizing the granting of patents. See Act of 1836.

In the case of Corning *vs.* Burden, 15 Howard, p. 267, this Court said, "A process, *eo nomine*, is not made the subject of a "patent in our act Act of Congress. It is included under the general "term 'useful art.' * * * * * "Where the result or effect is produced by *chemical action*, by the "application or operation of some element or power of nature, or of "one substance to another, such modes, methods, or operations are "called *processes*. *A new process is usually the result of a discov-*"*ery.*"

The new process of Tilghman was based upon the discovery which he had made, viz; that water, highly heated and retained in a liquid state (that is, prevented from being converted into steam,) in a close vessel under pressure, possessed by itself the *chemical power* of decomposing neutral fats into fat acids and glycerine.

Tilghman, in his patent, announces his discovery and also describes two modes of carrying out his process based thereon.

The first mode is announced by him in the following language: (Record, p. 8.)

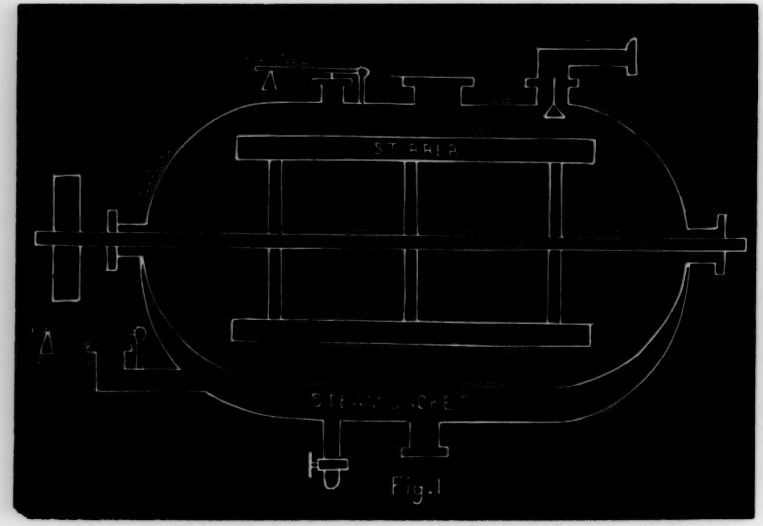
"My invention consists of a process for producing free fat acids "and solution of glycerine from those fatty and oily bodies of ani-"mal and vegetable origin, which contain glycerine as their base. "For this purpose, I subject these fatty or oily bodies to the action "of water at a high temperature and pressure, so as to cause the "elements of those bodies to combine with water, and thereby ob-"tain at the same time free fat acids and solution of glycerine. I "mix the fatty body to be operated upon with from a third to a "half of its bulk of water, and the mixture may be placed in *any con-*

"*venient vessel* in which it can be heated to the melting point of "lead, until the operation is complete. *The vessel must be closed* "and of great strength, so that the requisite amount of pressure may "be applied to prevent the conversion of the water into steam."

In connection with this description in the specification of Tilghman, the then existing condition of apparatus in the art of treating fat should be understood.

In the alkaline saponification processes, which were in use prior to Tilghman's invention, closed boilers, provided with safety valves, were known. In fact the safety valve was considered an indispensable appendage to a closed boiler from the time of Papin, 1682. It was also known that fat and water would tend to remain unmixed in a boiler, and therefore agitators or circulators, for preserving a mixture or intimate contact between the fat and lime and water during the process of alkaline saponification, were in use.

These apparatus were proved to have existed, by the testimony of Professor Booth, and also by prior patents and publications. Thus:



In Radley and Meyer's patent, fat and water and alkali were boiled under pressure in a vessel made as shown in Figure 1, which it will be noticed was a closed boiler and had a safety valve and a revolving mechanical agitator. See Record, p. 266.

Figure 2 represents a closed boiler, used for treating fat, lime and water with a churn-like agitator, which was described by De Milly in 1834. (Record, p. 266.)

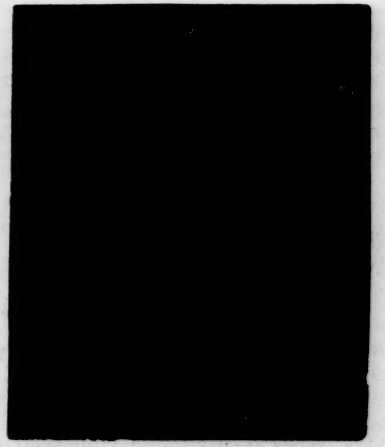


Figure 3 represents an apparatus used by Alliot in 1851, consisting of a closed boiler used for heating fat, alkali, and water together, in which a rotary pump was used to draw up the water and alkali from below and discharge it continuously on top of the fat, through which fat the water and alkali continually descended. (See Record, p. 266.)

It has been frequently decided that known machines need not be described when they are to be used in carrying out a new patented invention.*

*In Household & Co. *vs.* Neilson—Webster's Patent Cases, p. 687—the Court says: "Now I have to observe to you that the specification is to be read as addressed to

After describing his continuous apparatus, Tilghman gives the following general instructions in his specification:

"*The melting point of lead has been mentioned* as the proper "heat to be used in this operation, *because it has been found to* "*give good results.* But the change of fatty matters into fat acids "and glycerine takes place with some materials (such as palm oil,) "at, or below, the melting point of bismuth, yet the heat has been "carried considerably above the melting point of lead without any "apparent injury, and the decomposing action of the water becomes "more powerful as the heat is increased. *By starting the appara-* "*tus at a low heat, and gradually increasing it, the temperature* "*giving products, most suitable to the intended application of the* "*fatty body employed, can easily be determined.* Record, p. 9.

Mr. Tilghman also describes in his specification certain thermometric tests for carrying on the process.

"To indicate the temperature of the tubes *d*, *d*, *d*, I have found "the successive melting of metals and other substances of different "and known degrees of fusibility to be convenient in practice; sev- "eral holes, half an inch in diameter, and two or three inches deep, "are bored into the solid parts of the castings surrounding the "tubes, each hole being charged with a different substance. The "series I have used consists of tin melting at about 440° F., bismuth "at about 510° F., lead at about 612° F., and nitrate of potash at "about 660° F."

Record, p. 9.

---

artists or persons of competent skill in the branch of manufacturing, or process to which it is applicable. *Hence known machines need not be described when the use of them is to be made in carrying out the object of the patent.* For instance, if in an apparatus for improving the making of gas, a patentee should not mention or allude to a condenser, never notice it; yet in practice, if that is a part in all apparatus required in the making of gas, it was held that every one must know that a condenser must be used."

"In short, you are speaking to people who know the subject, and must be understood to know those things which are only the incidents in the particular process to which your patent applies."

The American decisions are to the same effect.

Emerson *vs.* Hogg, 2 Blatchford, 9.

Old and well-known machinery with which the new contrivance is to be connected, need not be described in the specification or delineated in the drawings, when no change in their forms or proportions enter into the new invention."

Brooks *vs.* Jenkins, 3 McLean, 447.

"Parts of machinery and processes generally known need not be described."
Same point in Kneass *vs.* Schuylkill Bank, 4 Wash., 14.

EXPERIMENTS AND TESTS AS TO PRESSURE AND TEMPERATURE MADE BY TILGHMAN BEFORE HIS APPLICATION.

In the "supplemental" testimony taken in this case Tilghman describes the development of his invention prior to his application.

Record, p. 1008.—He says that in addition to his experiments with the coil apparatus he made hundreds of experiments with this decomposition in simple digesters *before the use of the coil apparatus had been thought of for this process.*

These digesters, he says, were made of iron tubes somewhat more than an inch in bore, and 16 to 24 inches long; the stopper was fastened by a strong iron wedge, and a three-eighth of an inch iron rod, with a heavy brass knob at the end, and about six inches long, was left in the tube to act as a mixer.

Into this digester, Mr. Tilghman continues, measured quantities of fat and water were placed, in joint bulk, sufficient to fill it about four-fifths full. The top was then wedged on, and the digester heated by a gas stove to the desired temperature, and then shaken vertically so that the rod or "jumper," as he calls it, would thoroughly mix the layers of fat and water. Other devices for mixing these materials were also used by him, as rotating the digester in which he had placed thin copper partitions. Steam, of course, was in all cases present, as otherwise the digester would inevitably have burst.

The temperature used in these experiments Tilghman ascertained by means of a series of fusible alloys, against which he would rest the end of the digester and so find out which it would melt.

He more fully describes these experiments at p. 1012:

"*Question* 8. Prior to applying for your patent did you work your "process of decomposing fats into fat-acid and glycerine by the use "of water heated under pressure at temperatures below melting lead "or melting bismuth, and if so, at what temperature and pressure, "and with what result?"

"*Answer.* Before applying for my patent I had made many ex- "periments in decomposing by water at temperatures below melt- "ing bismuth, sometimes in the coil form of apparatus, but most "frequently in digesters. The lowest temperature tried by me was

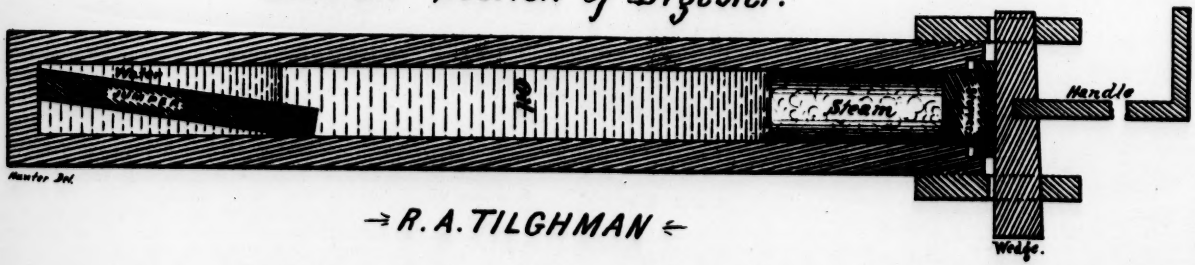
"three hundred and fifty degrees Fahr. (350° F.), or 120 pounds "pressure continued for four hours. The digester was as usual "in a vertical position, but the heat was in this case given by "an oil bath. I obtained both fat acids and glycerine in this ex- "periment, but in such small quantities as to prove that though the "decomposition did go on at that heat, yet it was very slow com- "pared with the higher heats. I find notes of another experiment "July 15th, 1854, in the coil apparatus, with palm oil, made at the "melting point of tin, 440° Fahr., 360 pounds pressure.

"It was pumped through the coil very slowly, so as to give "about thirty minutes' heat, and found to be partly decomposed, so "that it was returned to the inlet end of the apparatus and pumped "through a second time at the same rate and heat, which produced "perfect decomposition of the palm oil into fat acids and solution of "glycerine. Ten minutes' exposure would have perfectly decom- "posed palm oil at the heat of melting bismuth, 510° F. Yet I "found 70° lower heat required six times as long to produce the "same effect.

"I had often decomposed tallow at 510° F. before taking out "my patent, not in the coil apparatus, but in the simple vertical di- "gester. In this case I had to allow increased time on account of "the imperfect contact of the fat and water in addition to that re- "quired by the diminished temperature."

Having thus described his experiments with various forms of apparatus and his tests as to the efficiency of the different temperatures and pressures, from 350° F., or 120 pounds pressure, to a pressure and temperature exceeding that of the melting point of lead, Tilghman gives his reasons for preferring high pressures and for recommending the use of the coil apparatus.

Exhibit "Section of Digester."

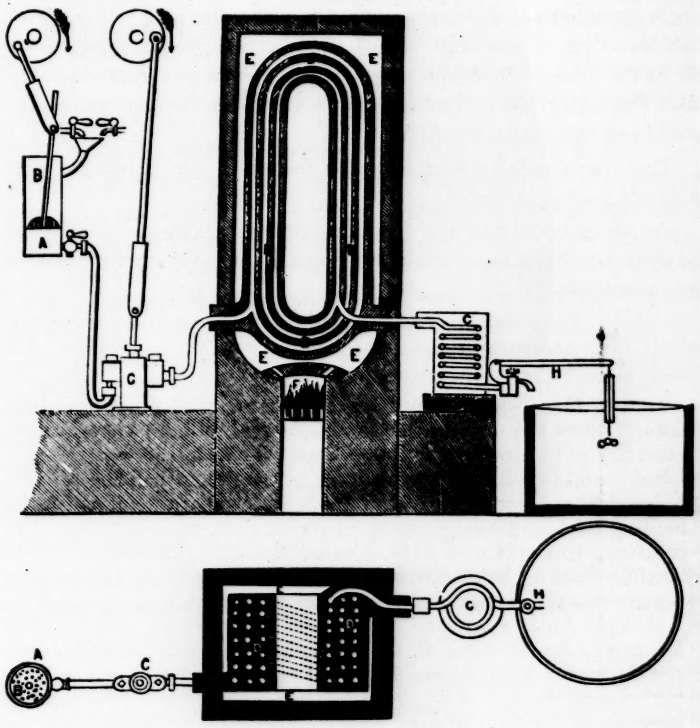


→ R. A. TILGHMAN ←

THE CONTINUOUS APPARATUS.

This is described by Tilghman, in his patent, as a means whereby his process may be carried on continuously by causing the mixture of fatty matter and water to pass through a tube or continuous channel such as is illustrated in the drawing.

Cut *d*.



The feature of this second form of apparatus consisted in making a tube of such length that the mixture of fat and water might be passed gradually through the tube and be heated in the passage, so as to come out at the end decomposed into fat-acid and glycerine.

The marked features of this special apparatus were,

1st. A continuous tube, arranged so as to be heated along its entire length.

2d. A pump to force the materials in at one end.

3d. A spring valve at the other end, to permit the escape of the fat acids and glycerine at that end, and yet retain the contents under the requisite pressure.

It will be seen that the length of tube and degree of heat, and the frequency of discharge, might be so regulated that the pump might be vibrated at regular intervals, and a fresh supply of materials forced in at one end, and of decomposed products be forced out at the other. If steam were permitted to accumulate and displace the water away from the fat in the tube, the decomposition would not take place regularly.

This continuous apparatus is fully shown in the drawing of appellant's patent, at Record p. 10.

At pages 1008–9 of the Record Tilghman explains his reasons for deeming this apparatus the best means for carrying out his process as follows:

"*Q.* 4. Why did you recommend, in your patent, the use of "such high temperatures as the melting point of bismuth and "lead?"

"*Ans.* Many experiments had shown me that at these higher "temperatures the decomposition was carried on with the greatest "economy of fuel and cost of apparatus. When in London in 1847, "I had found Perkins' house warming apparatus, consisting of coils "of hundreds of feet of pipe, containing water at the temperature of "melting lead, had long been in extensive domestic use there. On "returning to London in 1853, I found the same apparatus largely "used for heating bakers' ovens. As I thus found such heats and "pressures were perfectly practical and safe, as well as economical, "*I thought I was bound to describe my invention in what I then* "*believed to be the best mode of carrying it out, and that, as I was* "*the discoverer of the chemical facts,* I could then claim broadly as "my process the use of water highly heated and under pressure to "decompose fats, no matter what temperature or apparatus was "used."

"*Q.* 5. After your experience, what is your present view as to "the practicability, economy and safeiy of the higher temperatures "as compared with lower temperatures?"

"*Ans.* I think the high pressure apparatus is much more eco- "nomical, both in the first cost and in the expenses of working."

"Its principal disadvantage is that ordinary engineers are not "familiar with its management, and consequently dislike it. As to

"its safety, compared with the so-called low pressure apparatus "used in Cincinnati, say three hundred pounds per square inch "(*over double that used in locomotives*), the testimony of Mr. "Nason agrees with my experience and expresses my opinion en- "tirely, viz, the bursting of a long, narrow pipe filled with water "at lead-melting heat, opens but a few inches of the weld and leads "only to a hissing escape of steam, continuing several seconds till "the pipe is empty; the quantity of heated water is so small, and "the escape of steam is so graduai, that there is nothing like an "explosion, and no mischief is done. Whereas, a common boiler "containing tons of water at 100 pounds pressure, bursts suddenly "with an explosion like a bombshell, producing destruction all "around."

Having shown two modes of carrying out his process, one in the ordinary close vessels known in the arts, and the other in a continuous method of operation in a special apparatus, and having also stated temperatures at which he had worked well, and having given a rule by which the temperature can be fixed by any one, he claims no special apparatus and no special temperature, but he declares,

"I claim as of my invention, the manufacturing of fat acids and "glycerine from fatty bodies *by the action of water at a high tem-* "*perature and pressure.*"

INTRODUCTION INTO USE.

Tilghman patented his process in England, January 9th, 1854, and introduced it there both in his continuous method and in the ordinary digester.

George F. Wilson stated in a public lecture delivered by him in January, 1856, (see Record p. 112, G. T. Wilson, Jour., Society of Arts, London.)

"In January, 1854, Mr. Tilghman, an American chemist, who "has studied all that has been published here and in France, on "the subject of acidification and distillation of fatty bodies, obtained "a patent for exposing fats and oils to the action of water at a high "temperature and under great pressure, in order to cause the com- "bination of the water with the elements of the neutral fats, so as "to produce at the same time free fat acids and solution of glycer- "ine. He proposed to effect this by pumping a mixture of fat and "water, by means of a force pump, through a coil of pipe heated to "about 612 Fahrenheit, kept under a pressure of about 2,000 pounds "to the square inch; and he states, that the vessel must be closed, "so that the requisite amount of pressure may be applied to pre-

"vent the conversion of water into steam. This is, all must admit, "*a beautiful, original, chemical idea, well carried out;* it has yet "to prove how far it can compete successfully with distillation. "We have made an arrangement with Mr. Tilghman which will "give us the means of testing its commercial merits."

In July, 1857, Tilghman introduced his process into Price's candle factory in London, in an ordinary long boiler with a revolving stirrer, working at a temperature of about 400° F. (225 pounds pressure), and having a capacity of treating two and a half tons of fat at a charge, or about 10 tons a day. This appears by a letter of appellant, given in evidence by appellee, at Record p. 415, in which it is stated:

TILGHMAN'S LETTER, JULY 20TH, 1857. DEFENDANT'S EXHIBIT B.—DECEMBER, 24TH, 1868, R. E. S.

London, July, 20th, 1857.

To M. De Fountainemoreau:

Dear Sir:—In compliance with your request, I proceed to describe the present state of the apparatus for decomposing fats, as it is now being worked at Messrs. Price & Co.'s.

As I have before mentioned to you, it consists of a boiler thirty-two inches in diameter, and thirty feet long, made of iron nine-sixteenths thick, and lined with copper.

It is heated by an interior copper serpentine, *a retour d'eau*, which is supplied with steam from a smaller tubular boiler, (thirty-two inches diameter by ten feet long, with eighteen flues, three inches diameter). It also has a tube pierced with holes to inject free steam. The apparatus is worked at a pressure of from two hundred to two hundred and twenty-five pounds per square inch, (fourteen to fifteen atmospheres); it is charged with two and a half tons palm oil and three-quarter tons water, and the oil is perfectly decomposed in four and a half hours after the above pressure is attained. The decomposition would be effected in shorter time if a larger proportion of water was employed, and if agitation and mixture of the materials was produced by the injection of free steam from the pierced tube, but as one object is to get the glycerine in a strong state, (the demand for glycerine being just now greater than they can supply), they prefer for the present to work it as described.

Price & Co., are now thinking of putting up another apparatus, which will probably be constructed to work at a pressure considerably higher than above mentioned, so as to shorten the time of de-

composition, and also will be made to work continuously so as to avoid loss of time in filling and emptying.

Very truly yours,

R. A. TILGHMAN,
14 Southampton Place.

It appears by a letter given in evidence by appellant, at page 740 of the Record, that this apparatus continued at work at Price's factory down as late as 1865. See Tilghman's letter, admitted in evidence at Record, p. 740.

COMPLAINANT'S EXHIBIT, WILSON.

Price's Patent Candle Company, Limited.
Belmont Works, Battersea, London, S. W., July 13th, 1865.

R. A. TILGHMAN, ESQ.,

1123 Spruce Street, Philadelphia.

DEAR SIR: I thank you for your letter of 19th of June, which I have laid before the directors to-day, and they will be much obliged if you will, as you kindly offer, procure for us tracings of the working drawings of the apparatus now in use for your process in America, and most approved of by you, at any such cost as you mention, of about twenty dollars. You will tell us in sending them how to pay the money.

You are right in supposing that the apparatus we have now at Battersea is just what you saw or heard about when you were here. There is a stirrer in each vessel, but plainly insufficient for the proper contact of the water with the fatty body. I should think we may very probably use our present digesters for the outer iron vessels of your apparatus, putting them, of course, upon their ends. They are very much the shape of the vessels you describe. You do not mention what quantity of water you put to the fat. I should think it might be well to put it in at two doses, drawing off the first when it has taken up the bulk of the glycerine, and then finishing off with fresh water to take the last part of it away, using this water again as the first water for a fresh change of fat; but very likely you already do this. The whole of your letter now being replied to as well as of the previous one, was of much interest to us. If any further matters occur to you as worth mentioning in connection with the working of the process on your side, we shall be much obliged by your stating them when you write again.

I am, dear sir, yours faithfully,

J. P. WILSON.

While Tilghman was introducing his process into use in the form of the old convenient vessels in England, he also endeavored to induce parties in France to introduce it in the continuous form of operation, and actually had a coil apparatus successfully at work there for some time in 1855, and another apparatus embodying a modification of the continuous process was worked successfully, so far as the product was concerned, in 1858–59.

The failure in practice of these machines was due to the ill-advised modifications in structure introduced by Moinier & Co., contrary to Tilghman's advice and protest. (See Record, pp. 1010–1011.) Meanwhile Tilghman returned to the United States and introduced his process at Rope's factory, in Cincinnati, in 1860. At Rope's factory they used a long closed boiler, with a revolving stirrer, and worked at a temperature of 367° Fahr. (150 pounds pressure.) Record, page 116. This apparatus went into operation in January, 1860, and decomposed 9,000 pounds of fat per day, and has continued in operation.

In 1862 Tilghman put in operation his process at the factory of C. T. Jones, Cincinnati, using an old and well-known form of apparatus, similar to Alliot's boiler, where the water was continually pumped up and discharged on top of the fat. This process was worked upon charges of 6,000 pounds daily, under Tilghman's license.

It is further in evidence that in 1867 ten factories in the United States were working the water process under license from the appellant. (Record, page ——.)

In 1865 Tilghman's process being, as stated, largely in use in the United States and Europe, the appellees, who had been for some time infringing his patent, concluded the agreement with him set out at page 11 of the Record.

COMPLAINANT'S EXHIBIT C.

[STAMP.]

It is agreed between Richard A. Tilghman and Procter and Gamble as follows:

Procter and Gamble are to pay to said Richard A. Tilghman six thousand dollars ($6,000.00), six months after date, and are to be released without further payment for all liability from infringement of the patent of R. A. Tilghman, dated October 3rd, 1854, for "improvements in purifying fatty bodies," from its date to the present time.

Said Tilghman is to license the said Procter and Gamble to work under said patent upon the payment by them of a royalty of twenty (20) cents per 100 pounds of fat treated after the erection of the apparatus hereinafter provided for, and 10 cents per 100 pounds of fat treated by their present process, until said apparatus is completed and in working order.

Said Tilghman is to have erected in the factory of said Procter and Gamble, as soon as possible, an apparatus similar to the one procured by him, Jones, and Conahan, said Procter and Gamble paying the bills for materials and labor as the same become due, and said Tilghman superintending the construction and erection of said apparatus without charge.

(Signed,) R. A. TILGHMAN,
PROCTER AND GAMBLE.

Cincinnati, Feb. 24, 1865.

Under this contract the appellees continued to pay royalty until the expiration of the original term of the patent, when (an extension of the same having been obtained,) the subjoined correspondence took place between them and Tilghman.

Record, pp. 11 and 12.

COMPLAINANT'S EXHIBIT D.

1123 Spruce St., Philadelphia, Pa.,
December 30, 1867.

PROCTER and GAMBLE, Cincinnati, O.:

Gents—My patent, dated October 3d, 1854, No. 11,676, has been extended for seven years, commencing 9th January, 1868.

Our agreement, dated 24th February, 1865, relates only to the original term of the patent, expiring 9th January, 1868.

If you wish to continue to use the process after that date, a new agreement of license will be necessary. I am willing to grant a license upon substantially the same terms as heretofore, viz: 20 cents per 100 pounds of fat treated.

I enclose herewith duplicate copies of an agreement to that effect, which, if you think proper, you can sign and send to me, and I will sign and return one to you,

I propose to furnish printed forms for the monthly statements.

Please let me know your decision on the subject before the 9th January, 1868.

Very truly yours,

(Signed,) R. A. TILGHMAN.

EXHIBIT E.

Cincinnati, January 6, 1868.

R. A. TILGHMAN, ESQ., Philadelphia,

Dear Sir—Yours of 30th ult., to hand. Enclosed please find the contracts, signed as desired by you. Please return us one signed by yourself, and oblige

Yours truly,

PROCTER & GAMBLE.

The contract Exhibit F., Record, p. 12, was then, January 9, 1868, signed by the parties.

EXHIBIT F.

Memorandum of an agreement made this ninth day of January, 1868, between Richard A. Tilghman, of Philadelphia, chemist, of the one part, and Procter and Gamble, of Cincinnati, manufacturers, of the other part.

Whereas letters patent of the United States, dated 3rd Oct., 1854, No. 11,766, have been granted to said Tilghman for an improvement in processes for purifying fatty bodies, which patent expires on the 9th Jan'y, 1868, *and whereas* said patent has been duly extended for the period of seven years, from and after the 9th Jan'y, 1868,

And whereas said Procter and Gamble have hitherto been using and working, and are desirous to continue to use and work, the said patented process, under a license from said Tilghman:

Now, this agreement witnesseth the said R. A. Tilghman hereby licenses said Procter and Gamble to use and work his said patented process during the extended period of the said patent, upon the following terms and conditions: The said Procter and Gamble agree to keep an accurate account of the quantity of fatty matter treated by them each day by the said patented process, specifying the number of charges worked and the weight of fatty matter in each charge, and within the first five days after the end of each month to send the said detailed account of the quantity treated in said month to said R. A. Tilghman, and at the same time to pay him at the rate of twenty cents for each 100 pounds of fatty matter treated. The said Tilghman, or his authorized agent, shall have the right to inspect the books of the firm, so far as may be necessary, for the purpose of verifying said accounts. The said R. A. Tilghman shall have the right to terminate this license if said Procter and Gamble shall at any time, after thirty days' notice in writing, neglect to account and pay according to the terms of this agreement.

In witness whereof the said parties have hereunto set their hands the day and year first above written.

(Signed) PROCTER AND GAMBLE.
[Stamp] R. A. TILGHMAN.

Under this contract the appellees continued to pay royalty until the first of May, 1870, the date of the last payment. Shortly afterwards Mr. Tilghman received from them the letter.

COMPLAINANT'S EXHIBIT G. p. 13.

[Established 1837. Candles, Starch, Soap, Oils.]

Office of PROCTER & GAMBLE.

R. A. TILGHMAN, Esq., Phila.,

DEAR SIR: Having consulted counsel relative to our existing contract with yourself for processes employed by us in decomposition of fats, and being advised, in view of the facts in the case, we are not liable to you, we shall decline to make further payments.

Yours truly,

(Signed) PROCTER & GAMBLE.

To this he replied revoking appellees' license, p. 13.

COMPLAINANT'S EXHIBIT H.

1114 Girard St., Phila., July 11th, 1870.

PROCTER & GAMBLE, Cin.,

GENTLEMEN: I have received your note of June 30th, stating that you decline to make further payment under your contract. I am rather surprised at your taking such a course at this partciular time, when a decision as to the validity of my patent may be shortly expected.

If that decision is (for the third time) in my favor, injunction will immediately be issued against all infringers, and I am at a loss to understand why you should put yourselves in a position to have your works stopped.

If there has been anything developed which you think may, in a future trial, be decisive against the patent I should be glad to be informed of it, as it may save trouble and expense to us both to be able to form a correct judgment in any such matter.

I have hitherto defended my patent in the firm belief in its validity, sustained thus far by the decisions of two courts, but I think I am still open to conviction should anything plainly fatal to it be, even now, brought forward.

I doubt if Messrs. Werk and Shillito would ever have commenced the present dispute had they not been deceived as to the real meaning and effect of the Radley and Meyer patent and the Perkins scum paper.

I enclose a copy of Mr. Harding's argument in reply in the pending suits.

The position taken by you in your last letter of June 30th, 1870, if persisted in, leaves me no alternative. I must therefore request that you consider this as the formal notice to account, and pay for the quantity of fat worked by you in the months of May and June, 1870, as provided in our contract of January 9th, 1868.

Respectfully, yours.

(Signed) R. A. TILGHMAN,

And the correspondence was closed by the following letter from the appellees' Record, p. 13.

EXHIBIT I.

Cincinnati, Aug. 2nd, 1870.

R. A. TILGHMAN, Phila.,

DEAR SIR:—Yours of last ult., to hand. We have placed the matter in the hands of Chas. B. Collier, Esq., of your city, and refer you to him.

Yours, truly,

(Signed) PROCTER & GAMBLE.

In disregard of the notice the appellees continued to use the process described by them in the answer, Record, pp. 18 and 19, which is the same previously employed by them under their license.

INFRINGEMENT.

1. Tilghman announces in his patent that highly heated water under pressure, would of itself decompose neutral fat into fat-acids and glycerine.

EXTRACT FROM APPELLANT'S SPECIFICATION.

"My invention consists of a *process* for producing free *fat acids* and *solution of glycerine* from those fatty and oily bodies of animal and vegetable origin which contain glycerine as their base. For this purpose, I subject these fatty or oily bodies to the action of *water* at a high *temperature* and *pressure*, so as to cause the elements of those to combine with water, and thereby obtain at the same time free fat acids and solution of glycerine." Record, p. 8.

2. He announced that in order to carry out his proces, it was necessary to have a strong vessel, and closed so as "*to prevent the conversion of the water into steam*, i.e., to retain the water in a liquid state at the same time it was exposed to the high degree of heat.

3. Tilghman mentioned in his specification, that as the heat is increased, the time of decomposition is diminished. Record, p. 9. "The decomposing action of the water becomes more powerful as the heat is increased."

4. He mentions ranges of temperature to be worked out, and provides convenient thermometric apparatus for testing those temperatures, *viz.*: from 440° F., melting point of tin, to bismuth at 510° and lead at 612°.

5. He mentions in *three* places that it is important to maintain the fat and water in an intimate state of mechanical mixture or contact during the operation.

Although Tilghman makes these five announcements, yet in the first part of his specification, where he states the nature of his invention, he limits himself to no precise temperature, provided that *water* highly heated and under *pressure* be used to decompose fats.

So also in the claim, he defines his invention as consisting in the use of highly heated water under pressure, to produce fat acids and solution of glycerine.

Appellant insists that the use of highly *heated water* under pressure, to decompose neutral fats into fat acids and glycerine, is an infringement of his patent, no matter what particular form of apparatus be used, or what particular temperature be adopted, and no matter what particular device be adopted to maintain the intimate mechanical mixture of the fat and water during the decomposing operation; these last being obvious matters of detail, susceptible of infinite variety.

The infringement of the appellees consists in placing highly-heated *water* with neutral fat in a close vessel, and restraining or confining it there under pressure, to preserve the water in a liquid state and thereby produce fat acid and a solution of glycerine.

1. Appellees use highly heated water under pressure as the decomposing agent.

EXTRACT FROM ANSWER, RECORD p. 18.

And the defendants represent that the process employed by them since the said 9th day of January, 1868, is conducted in an apparatus and under conditions substantially as follows, to wit:

The apparatus consists of a digester, or strong iron tank, of the dimensions of about twenty-five (25) feet in length and about four (4) feet internal diameter. Within said tank is placed a second tank, made of copper, slightly less, say four (4) to six (6) inches, in diameter than the exterior tank, the interior tank being bolted, at its bottom, to the exterior tank.

Into the interior tank there is placed fat and water in equal quantities, together with lime, in quantity equal to one per cent. of

the quantity of fat, the usual charge of fat being sixty-five hundred to seven thousand pounds, according to the quality and kind employed.

When the fat, water and lime have been placed in the digester or tank, the digester is not full by several feet.

Upon the introduction of the fat, water and lime, *superheated steam, at a pressure of between 200 and 250 pounds to the square inch,* is introduced near the top of the iron tank, and finds its way, through numerous holes left for the purpose, into the interior copper tank, and is there brought into contact with, and made to operate upon, the contents of the interior tank during the time that the charge of fat remains in the tank, during all of which period steam in large quantities is necessarily and intentionally present in said tank with the fat, that the duration of the operation is from nine (9) to ten (10) hours, during which period the first charge of water is drawn off and a second charge of water, about one hour before the completion of the digestion, is introduced.

Within the interior tank, about five (5) feet from its top, is placed a perforated diaphragm, and also within said interior tank is a pump, which during the process is constantly at work, and the function of which is *to preserve a constant agitation and intermingling of the contained contents,* by pumping the water from the bottom to the top of the vessel and discharging it on the upper surface of the fat, in order that it, the water, may, by its greater specific gravity, shower itself through the fat."

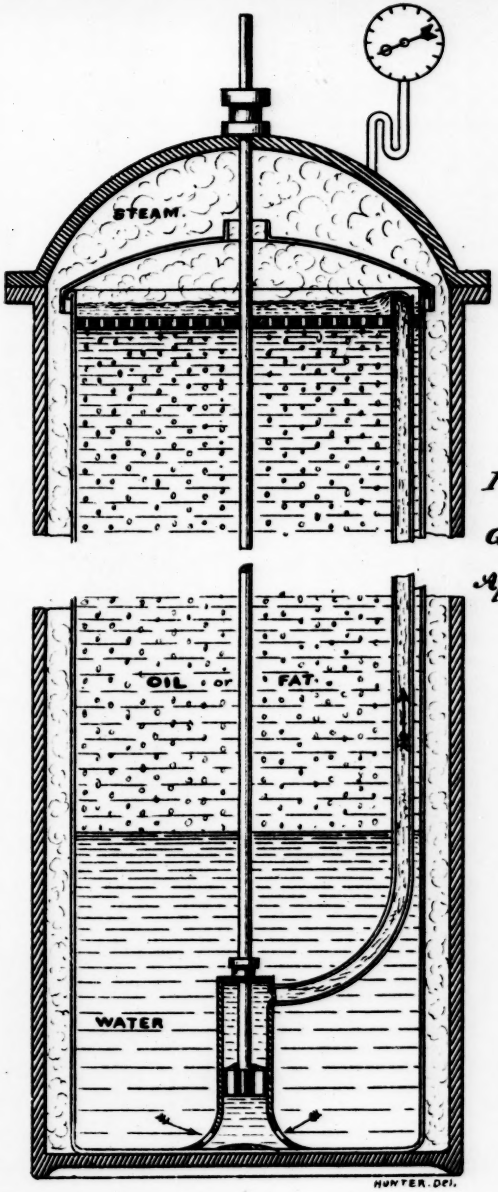
The Appellees then use water at a temperature corresponding to from 200 to 250 pounds of pressure and keep the water and fat in a state of intimate admixture by pumping the water from the bottom of their boiler upon a perforated diaphragm, through which it showers down upon and through the fat, thus, as the answer expresses it, p. 19, "preserving a *constant intermingling*" of the fat and water.

The necessity of this intermingling is expressed by Tilghman in his patent.

EXTRACT FROM PATENT RECORD PAGE 9.

"It is important, for the quickness and perfection of the decomposition, that the oil and water, during their entire passage through the heating tubes, should remain in the same state of intimate mixture in which they enter them.

"I believe that it will be found useful to fix at intervals in the heating tubes diaphragms pierced with numerous small holes, so that the liquids being forced through these obstructions with great velocity, may be thoroughly mixed together."



Proctor & Gamble's Apparatus.

Berthollet's Apparatus.

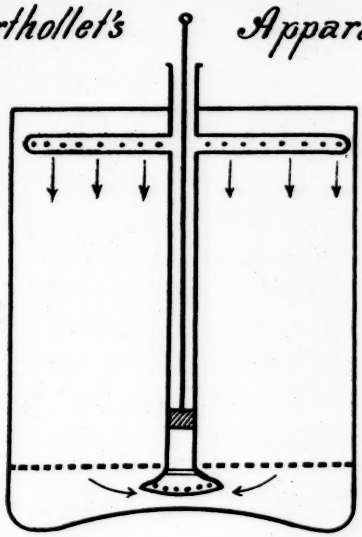


FIG. 7. 1824

Automatic Circulation Apparatus.

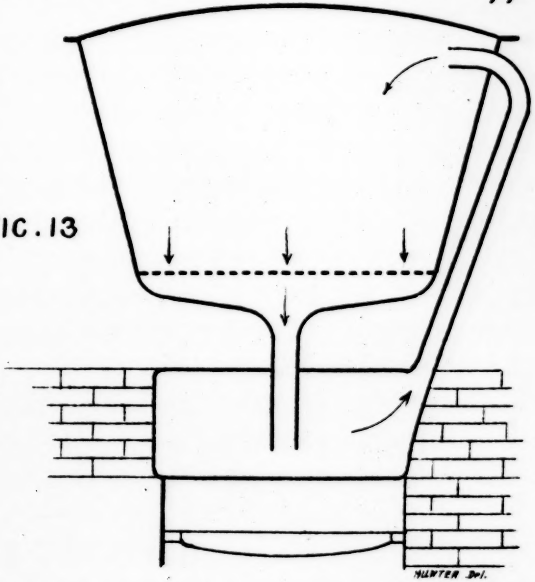


FIG. 13 1834

The use by the Appellees of a lower temperature and longer time than that recommended by the Appellant in his patent for the continuous apparatus, was a use contemplated by Tilghman and referred to in his patent (see Record, p. 1012), where he describes his experiments with his experimental apparatus as ranging in temperature as low as 350° F.=120 pounds pressure. As, however, these experiments demonstrated the fact that the greater the heat and pressure employed the more powerful and rapid were the chemical effects, and as he found the pressure employed by him in his continuous apparatus the *most efficient*, he did as he was bound to do, viz., detailed it in his specification as the preferable means for carrying into effect his invention. As was said by Wilson (anti p. ——), "this all must admit to be a *beautiful* original chemical idea, *well carried out.*"

Nothing could now be said on this subject of temperatures more clear or distinct than the words of the patent Record, p 9.

"The decomposing action of the water becomes more powerful as the heat is increased."

As to the presence of steam in the digester used by Appellees, it serves, and can serve no purpose other than the application of sufficient pressure to *keep* the water in a fluid state at the high temperature used. The requisite pressure, viz., enough to prevent the conversion of the water into steam, is just as certainly produced by the presence of confined steam as by the boiler entirely filled by the fluid. It is clear from a reading of the specification that the direction to avoid the presence of steam applies only to the continuous apparatus (Record, p. 9), the only requisite of the "convenient" vessels before referred to, being that they shall be *closed*, an indication, simply, that a pressure *greater* than that due to the temperature at which steam is produced at the pressure of the atmosphere, *i. e.*, 212° F., was to be used. (Record, p. 8.)

In all the hundreds of experiments tried by Tilghman with the digester before described, steam was present necessarily and harmlessly, and it will hardly be seriously pretended by the Appellees that the presence of steam in their digester produces any chemical effect, or in any way aids the super-heated water in its decomposing effect.

Appellee's own experts admit that steam is not *essential* to his process, and they say that if steam was not used, but the materials

heated in any other way, the same products would be obtained as when steam is used. See Mitchell, R. p. (775–6, xQ. 171), Smith, R. p. (810, xQ. 58), Rand, R. (p. 885, xQ. 30.)

That steam *by itself* acting on fat at 320°, under pressure and *without distillation*, will not produce any appreciable fat acid, is proved by the fact stated by appellee's witness Verdin (R. p. 242, Q. 12), that the product of Wilson's tank process, fat heated by steam at fifty to one hundred pounds pressure for ten to fifteen hours (appellee's Exhibit), still remained *neutral fat* and was known and used in commerce as such, Jones, R. (p. 34, Q. 12), also in Walther's process (appellee's Exhibit 17, R. p. 576.) The same result, neutral fat, *and not fat acid*, was produced by the action of high pressure steam upon oils and tallow, Booth, (R. 608, Q. 134.)

The non-action of steam, *per se*, is also proved by appellee's witness Grant (R. p. 95, Qs. 39–42), who treated more than a million pounds of fat at 350° F., with steam heated to 800° F., and found the product to be still *neutral fat.*

Great stress is laid upon the presence and decomposing action of steam on fats by appellee's experts, Smith, Wayne, and Rand. It is true none of them had ever tried a single experiment on the subject, but they are, nevertheless, full of theoretical confidence that it is as active, and some say more active, than water at the same temperature. Booth (R. p. 588, Q. 30), decomposed animal fat into fat acid and glycerine by the action of water at 612° F. in five minutes. Now Wilson, the discoverer and patentee of the process of steam decomposition of fats, required from 24 to 36 hours at the same heat to decompose a charge of palm oil. See Report of Juries of the Exposition Universelle de 1855, p. 496—immediately preceding appellee's Exhibit (R. p. 910.) Taking 30 hours as the average time required by steam, it is 360 times as long as required by water in Booth's experiment; but it must be remembered that palm oil contains an average of about 50 per cent. of free fat acid already formed in it, which distils with the greatest facility, so that if the charge had been all neutral fat, as it was in Booth's experiment, a far greater time would have been required. In addition to this, Booth used an animal fat known to be far more difficult of decomposition than the palm oil used by Wilson, so that altogether it is probable that the decomposing power of superheated water on fats is at least six or eight hundred times that of

steam at the same temperature. The intolerable slowness of this process would alone prevent its adoption for any practical use, but when we add the uselessness of its fatty product from imperfect decomposition, testified to by Tilghman (R. p. 1029, Q. 59), it seems to reduce it to a mere "*chemical curiosity.*"

To refer to the co-operation and assistance of the action of steam to that of super-heated water in decomposing fats is like talking of the help a donkey would give to a locomotive.

As to the use of about a half per cent. of lime with the mixture treated by the appellees (Record, p. 19), it is clearly immaterial. The use of an alkali is recommended in the patent Record, p. 10, as sometimes necessary to prevent the injurious effects of some of the soluble acids present in fat, upon the shell of the boiler, and Tilghman explains (Record, p. 1013) that his experiments included many in which he introduced lime.

"*Q.* 9. Prior to the date of your patent did you ever use any al-
"kali to facilitate the decomposition of the fat by the water at high
"heats?

"*Ans.* I did, and made many experiments with it, using both
"lime and soda in quantities ranging from one-half of one per cent.
"up to two per cent. of the weight of the fat."

"*Q.* 10. Then why did you not recommend in your patent such
"use of alkali to facilitate the decomposition?"

"*Ans.* Because I considered the disadvantages attending its use
"exceeded its benefits; the use of alkali in the process impairs the
"quality and consequent value of the glycerine produced to a se-
"rious extent. R. G. Mitchell, a witness in this case, uses water
"only, and gets a much higher price for his glycerine than those
"manufacturers who use lime also. When C. H. Grant, of Phila-
"delphia, was working the process in 1860, the injury to the qual-
"ity of the glycerine by the use of any lime in the water was often
"mentioned to me by Mr. Bower, who was refining Grant's glycer-
"ine for sale, and Grant avoided the use of lime for the mass of the
"fat decomposed by him.

"In addition to the injury of the glycerine, the lime involves
"considerable trouble and expense in removing it from the fat acids.
"Both sources of injury are avoided, either by using a longer time
"in the decomposition at the same pressure, or by simply increasing
"the pressure, the time required for the decomposition can be
"shortened without appreciable increase of expense.

"I mention in the patent the only result of my experiments with
"the use of alkali that I considered valuable. I found some fats
"developed in their decomposition by water so much acetic or other

"similar acid as to dissolve portions of the iron tubes, and I directed "in the patent the previous addition in such cases of sufficient alka- "line or basic matter to neutralize such acids. I found subsequently "that such acid-producing fats, instead of being rare in commerce, "were almost the rule. *In fact I have never tested the glycerine "water produced in any candle-works using my process, in which I "did not find it to be acid, even when they had been using one per "cent. of lime with the fat.* When using a vessel lined with copper, "as it should always be for this process, I consider the use of any "lime in the operation to be a miscalculation of economy by the "manufacturer."

This answer clearly shows that the use of lime is a mistake involving poorer products and increased expense, but it is immaterial, so far as the patented process is concerned, whether lime is used or not, so long as it is not in sufficient quantities to neutralize and make soap of all the fat acids produced.

Premising there are none of the injurious acids spoken of by Tilghman present, each pound of lime in the appellees' mixture will take up and neutralize (theoretically) ten pounds of the fat acids, and to this extent, say one-tenth of the mass, the process used is simply the old lime saponification process, the product of which must be treated with acid, distilled, &c., in the old manner. As to the rest of the fat, the lime produces no effect, so that nine-tenths of the product is the result simply of the treatment of the neutral fat *by water alone* at a high temperature and pressure. See the testimony of Booth and Rogers in the Werk case, where a much larger proportion of lime was used than that employed by the appellees.

BOOTH, RECORD, PAGE 442.

"In Tilghman's process, fat and water are heated together in a "steam-tight vessel, above the boiling point of water, either without "the use of lime, or with the use of from ½ to 1 pound of lime to "100 pounds of fat. In Defendant's process, fat and water are like- "wise heated in a steam-tight vessel, by the use, according to my "analysis of the product, of about 5 per cent. of lime—per cent. re- "ferring, of course, to 100 pounds of fat. In Tilghman's process, "the vessel is heated by external heat; in the Defendant's process, "heat is transmitted into the interior, into the mixed water and fat, "by superheating steam. In Defendant's process there is not a dis- "tillation of fat acid, because it is performed in a steam-tight vessel, "under a pressure greater than that of air, and therefore *the only*

"*object of super-heated steam is to transmit heat into the interior of* "*the vessel.* In Defendant's process, about one-half of the fat is "saponified by lime, the other half is decomposed into fat acids and "glycerine by the superheated steam introduced into the mixture of "the water and fat acids in the vessel. *In Defendant's process the* "*object of introducing super-heated steam under pressure is to heat* "*the water beyond its boiling point, and thus effect the same de-* "*composition as is involved in Tilghman's process.* In Defendant's "process, the usual method of saponification by lime is performed "on about one-half of fat, the other half is decomposed into fat "acids and glycerine by water, which is heated above its boiling "point by superheated steam under pressure. This last half of the "fat is therefore decomposed on the same principle as in Tilghman's "process."

"*Q.* 25. Please state whether or not the chemical agent in pro- "ducing 50 per cent. of fat acid, in defendant's process, is water "at a high temperature under pressure?

"*Ans.* Yes, sir; it is."

ROGERS, RECORD, PAGE 458.

"This high temperature to which the Defendant, by his means "(*i. e.* introduction of steam,) subjects the mixture of water and fat "accomplishes directly, through the chemical agency of the water, "a transformation of a large portion of the fatty substances into "free fat acids and glycerine; and, therefore, so far as there are de- "veloped by Defendants' process any free fat acids and glycerine, "Defendant's process is identical with Plaintiff's. The production "of a smaller or larger amount of lime-soap through the use of "lime by Defendant does not at all exclude that principal of Tilgh- "man's process which is operating to so large an extent in the "defendants' process.

Q. 28. "You have stated that you have found by analysis a cer- "tain quantity of free fat acid in Defendant's product. Please state "whether or not the chemical agent in producing the free fat acid "in Defendants' process, as described, is water at a high tempera- "ture under pressure."

Ans. "The chemical agent which has produced the free fat acid in "the product of Defendant's process is undoubtedly water at a high "temperature under pressure."

Q. 29. "So far as the lime-soap in the Defendant's product is "concerned, state whether or not this lime-soap is produced by the "process described in Roret."

Ans. "The lime-soap contained in Defendant's product is produced "by the process described in Roret, and depends upon the same "chemical reaction of simple saponification of a fat by lime under "pressure. * * *

"*There are two distinct and independent chemical processes con-*
"*cerned in defendant's process; one consists in the production of*
"*free fat acids and glycerine, and the other in the production of a*
"*neutral lime-soap. The first named, 'the production of the free fat*
"*acid and glycerine,' is Tilghman's process. The second, the pro-*
"*duction of the lime-soap, is the process described in Roret.* * *

"It matters not how the heat is applied to the contents of the "tank in defendant's process, whether by superheated steam, ordi- "nary steam, or a common fire applied, since in either case the free "fat acids are developed through the same chemical action of water "at a high temperature under pressure, which is Tilghman's pro- "cess."

The pretense of the defendant in the Werk suit that his product was something else than lime soap *and* free fats acids, and the learned talk of his experts about *acid lime soap* is completely demolished by the simple physical test to which a sample of his product was subjected by Professor Booth.

Booth, R. p. 53.

Q. 53. Have you subjected defendant's product of December 17, 1868, to any mechanical treatment; and if so, with what result?

Ans. A quantity of defendant's product of December 17, was put between porous papers and gradually squeezed or pressed, at first cold and afterwards hot, until it ceased to grease the papers. The substance left between the papers was a hard, dry, white powder, not greasy to the fingers, which was analyzed, and contained lime 8.9 per. cent., and fat acid 90.3 per cent., and was a neutral lime soap. The greasy papers were treated with hot alcohol, which was then filtered and evaporated, and left a fluid oil, having all the properties of free fat acid. One hundred grains of it were burned, and left an ash weighing 0.49 grains of carbonate of lime, which is equal to 0.27 grains of lime. This lime was in the state of lime soap, and was dissolved by the liquid fat acid which was absorbed by the paper.

Q. 54. Does this separation of defendant's product into two different substances, by purely mechanical means, prove anything as to its nature?

Ans. It proves beyond a doubt that the defendants' product is a mechanical mixture of neutral lime soap, and *free fat acid.*

Besides this testimony of scientific men (and all the other experts examined in the case bear witness to the same effect,) we have in the testimony of the defendant's witness, Ropes, an expression of the way in which this question strikes a practical manufacturer of candles.

ROPES, RECORD p. 120.

"If I understand Mr. Tilghman's process, it is to produce a free "fat acid with one operation, under pressure, *either with or without* "*lime*; but if so much lime is used as to produce a lime-soap, it "goes without his process, right or wrong. I so understand it. * *"

How this composite process as it was used in Werk's case, strikes a body of impartial scientific men may be seen in the report of the jury of the London Exhibition of 1862.

Record, p. 743-4.

"Page 3. Considerations of this nature led M. de Milly, as early "as 1855, to endeavor to modify the process of saponification by "means of lime; instead of effecting this decomposition at a tem- "perature of 212°, and employing 14 per cent. of lime, he raised "the temperature by working under pressure, and employing only "4 per cent. of lime.

"At the present time M. de Milly has indeed reduced the pro- "portion of lime to 2½ per cent. This process has been imitated "in Austria. Undoubtedly it constitutes a real improvement upon "the ordinary method of saponification by lime; *but in spite of this* "*considerable improvement*, WHICH IS IN FACT BUT A COMBINATION OF "MR. TILGHMAN'S MODE OF SAPONIFICATION BY WATER AT A HIGH "TEMPERATURE COMBINED WITH THE LIME PROCESS, we cannot be- "lieve that these two methods of saponification, under any modifi- "cation at present attempted, can, in an economical point of view, "successfully compete with the sulphuric saponification."

All this testimony is about a process (Werk's), a considerable proportion of the product of which was a lime soap, and in which from 4 to 6 per cent. of lime was used in the digesters. The appellees use but 1 per cent. of lime, a quantity not even sufficient to neutralize the soluble acids which experience has shown to be generally present in the fats treated, and this use is pointed out and recommended in the patent.

TILGHMAN RECORD, PAGE 1013.

"* * * * I found subsequently that such acid-producing fats, "instead of being rare in commerce, were almost the rule. In fact, "I have never tested the glycerine water produced in any candle- "works using my process, in which I did not find it to be acid *even* "*when they had been using one per cent. of lime with the fat.* * * *"

Appellees' expert, Dr. Rand, having asserted that the *chemical action* was different where lime was used, was at last drawn into giving his *only reason* for his said assertion.

Dr. Rand, R. p. 891.

Q. 72. Then the shortening of the time of the operation when lime soap is used is the *only fact* which induces you to believe that the chemical action is probably different when lime soap is used?

Ans. It is the only fact. It is the effect referred to in my answer to cross-question 69.

The argument of Appellees' witnesses, that because the addition of lime soap *hastens* the action of the water in producing fat acids, *therefore* it prevents it from being the same chemical action or process is palpably absurd.

Other things hasten the action of the water far more than does the lime soap, and yet they admit that the chemical action and process remain the same, thus:

Mixture and agitation are proved to hasten the action from fifty to eight hours, a gain of forty-two hours (Verdin, R. p. 781, Q. 25).

Increase of heat hastens the action from twenty-four hours to five minutes, or two hundred and eighty-eight times, (Booth, R. p. 588, Q. 36).

In these cases Appellees experts admit the chemical action and process remain the same, (Smith, R. p. 829, xQs. 171–3; Wayne, p. 863, Q. 153, Rand p. 889, xQs. 59–60).

The hastening action of the lime soap is explained by Professors Booth, and Rogers, who show that it helps to form an emulsion or very intimate mixture of the fat and water, thus increasing their surfaces of contact.

APPELLEES' WITNESSES.

Wayne (R. p. 846 xQ. 45; p. 864, xQ. 160), and Mitchell, (R. p. 753, Q. 42), admit that lime soap does help to form an intimate mixture between the fat and water, and Dr. Rand (R. p, 896, xQ. 107) also admits that the formation of an emulsion would account for a hastening of the decomposition.

Upon Dr. Rand's attention being called (R. pp. 891–2, xQ. 76), to the following passage in "Storer's Dictionary of Solubilities," viz.: "When a neutral oil is dissolved in warm alcohol, and an alcoholic solution of potash added to it, the mixture is instantaneously saponified on being heated to boiling," and the question asked him p. (892, xQ. 76),

"It being well known that the saponification of oil by a watery solution of potash, required several hours boiling, I ask you whether the chemical action of saponification is the same in the two cases,"

He is compelled to answer.

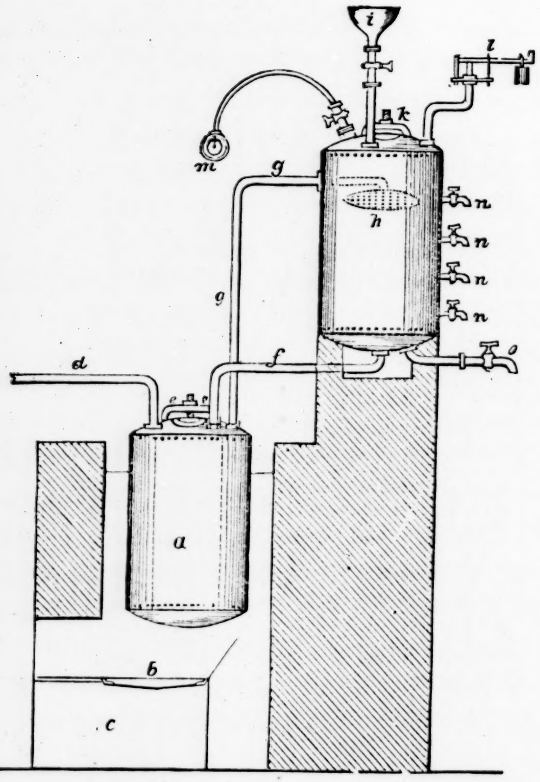
"*I do not think the chemical action is different.* * * * In the case of a watery solution of potassa, with oil in a state of mixture, the long time required is due to the fact that only small portions of oil and alkali can come into contact at a time owing to the insolubility of oil in water. *When the oil is dissolved in warm alcohol and added to an alcoholic solution of potassa, an intimate admixture takes place*, and the chemical action goes on rapidly at the boiling point."

In what is this gain in the rapidity of a process to be distinguished from that due to the use of lime in the super-heated water process of the Appellant.

The addition of lime or any other agent to act conjointly with or hasten the action of the water in decomposing the fat, is a mere modification of Tilghman's process, and even were Appellees the inventors of such modification, they would have no right to use it without his license. But beyond all this, the fact remains that the use of lime in such proportion as these Appellees use it, is actually spoken of in Tilghman's specification.

As to the identity of the Appellee's process with that patented by Tilghman, see in addition to that already cited, the testimony of Rogers, Booth, Genth, Bridges, and Gibbs, given in the Mitchell suit, where the process described in the Wright & Fouche patent was used by the Defendant.

This Wright & Fouche process was in all its features similar to that of Appellee's, save that the circulation was automatic instead of being produced by a pump, and the temperature used was lower, and attained by direct application of fire.



PROFESSOR J. C. BOOTH, RECORD PAGE 43.

Q. 6. State whether the process of decomposing fat into fat acids and glycerine, described in said patent of Wright & Fouche is the same or different from the process described and claimed in said patent of Tilghman. (Objected to by defendants' counsel, as not within the province of an expert).

Ans. It is the same.

PROFESSOR ROBT. E. ROGERS, RECORD PAGE 76.

Q. 4. Have you read, and do you understand the patent granted to Wright & Fouche. No. 22,765?

Ans. I have read and do understand the same.

Q. 5. Is the method of obtaining fat acids and solution of glycerine from neutral fatty bodies therein described the same, or a different process from that described in complainant's patent? (Objected to as not within the province of an expert.)

Ans. I consider it to be identical.

PROFESSOR ROBERT BRIDGES, RECORD PAGE 72.

Q. 5. Have you examined, and do you understand the Letters-Patent of Wright & Fouche, No. 22,765?

Ans. I have read, and do understand them.

Q. 6. Please state whether or not the process of decomposing fats in said process is the same, or different from that set forth in complainant's patent? (Same objection.)

Ans. I consider the process of decomposing fats, as set forth in the patent of Wright & Fouche, to be identical with that set forth in the patent of Tilghman.

PROFESSOR F. A. GENTH, RECORD PAGE 86.

Q. 3. Have you read, and do you understand, the patent granted to R. A. Tilghman, No. 11,766, and also the patent granted to Wright & Fouche, No. 22,755? and if yea, state whether the process of decomposing fats directed to be performed in Wright & Fouche's apparatus is the same or a different process from that described in Tilghman's patent? (Objected to as not within the province of an expert.)

Ans. I have read, and do understand, both patents mentioned in the question, and consider the process performed in either to be identical.

PROFESSOR WOLCOTT GIBBS, RECORD PAGE 20.

Q. 3. Have you read, and do you understand, the patent granted to the plaintiff, dated October 3, 1854?

A. I have read it, and do understand it.

Q. 4. Have you read, and do you understand, the patent granted to Wright & Fouche, dated January 25, 1859?

Ans. I have read it, and understand it.

Q. 5. (Objected to as incompetent.) State whether liquid water, highly heated and under pressure, is, or is not, the agent in both these patents by which fatty bodies are decomposed into fat acids and solution of glycerine?.

Ans. I believe that it is.

The testimony of Gibbs should have especial weight, because not only of his high standing as a chemist, but because he was deliberately selected by Mitchell to examine these subjects, and because he made up his mind adversely to him without ever having known or seen Mr. Tilghman or any one in his behalf.

It is also to be borne in mind by the Court, that Professor Gibbs, after a full examination of the subject on *behalf of Mitchell*, formerly reported to him that *Tilghman's process was new.*

No expert produced by Appellees has sworn that Tilghman's process is substantially the same with that described in any exhibit, or was ever known or used before the date of his patent.

No expert has ever sworn without an *if*, that Appellee's process is substantially different from that patented to Tilghman, while *five experts* of the highest scientific merit, unhesitatingly swear to the novelty of Tilghman's invention, and to the fact of infringement by the use of the Wright & Fouche apparatus.

The remaining point which the Appellees make on the question of infringement is that they use a lower temperature than that stated by Tilghman to be his preference.

The statement made in the answer that Tilghman was at the time of his application unaware that the desired change in the fats could be produced at any temperature less than that recommended in the patent (see Record, p. 18), is sufficiently met by the testimony already quoted concerning the experiments of Tilghman with both plain vertical and coil digesters, and his use of temperatures as low as 350° F. = 120 lb pressure. Record, p. 1012.

The reasoning of Appellees on this point seems to lead to an absurdity. They say, in effect, that the general does not include the particular, and that after the general announcement that water at a high temperature and pressure would decompose fats, it still remained unknown that it would do so at *any particular* high temperature and pressure.

It would follow logically from this, that the day after Appellant's patent, another person could have obtained a valid patent for using the same process at all temperatures not specifically mentioned by Appellant, and that each succeeding day a new valid patent could be obtained for the same process, applied at each particular degree of temperature, and that the last patent as to its specified degree, would be better in law than the first one, which announced the broad general discovery.

Appellant's discovery was that water at a high temperature and pressure had a certain chemical power; that it was for this purpose a new chemical agent. If his discovery had been that nitric acid would produce fat acids, and he had said, I prefer to use strong

nitric acid of 20° B., but weaker acid will act less powerfully, and I claim the use of nitric acid generally, could Defendants have used nitric acid of 1° B., and said that was a different invention?

Appellee's experts are compelled to admit that the chemical action of water upon fat is the same at 300° as at 612° F., and is merely slower at the lower temperature. Wayne, Record, p. 863.

X Q. 153. Then I understand you to say that from 300° F. to over 612° F., the chemical action of water upon fat to produce fat acid and glycerine, is substantially the same; is that so?

Ans. That is so.

(Dr. Rand, Record, p. 890.)

X Q. 61. Then if in operating with fat and liquid water alone at 320° F., any part of the fat is converted into fat acids and glycerine, the process, chemically considered, is the same as Complainant's patented process; is that so?

Ans. It is.

FINALLY.

Of all the agents (lime or lime-soap, steam or super-heated water,) which are *supposed* by Appellees' experts to act in conjunction in Appellees' process, the super-heated water is the only one which is *essential* to the production of the fat acids and glycerine, and which can *by itself* produce this result.

This is demonstrated by a series of sifting experiments, leaving out, in turn, each one of the supposed agents.

If we find that the result is produced even where one of the supposed agents is absent, we may safely conclude that one is not the active efficient agent—the *sine qua non.*

And if we find that, when one of the supposed agents is absent, the result is never produced, but that when it is present the result is always produced, we may reasonably conclude that this one is the active efficient agent.

Leaving out of consideration the soluble acids spoken of by Tilghman, it is agreed, on all sides, that the lime used by the Appellees immediately combines without $\frac{1}{10}$ of the fat and produces lime soap. Therefore the supposed agents are reduced to three: steam, lime soap and water. Which one of these substances, acting on fat at 320° to 330° Fahr., will produce free fat acids?

1. Steam. Defendant's experts admit that if steam was absent from Defendant's digester, the product would be the same as when it is present. (Deft's Testy., Mitchell, pp. 775–6; Smith, p. 810; Rand, p. 885.)

Defendant's witness, Grant, says he has heated more than a million pounds of fat to 350° Fahr., with currents of steam heated to 800° passing through it, and the fat remained neutral. (Deft.'s Testy., pp. 925–6)

Defendant's witness, Verdin, says that the fat treated by steam in Wilson's tank process, which goes up to 100 pounds pressure, 338° Fahr,, remains neutral fat. (Deft's Testy., pp. 785–6.)

Therefore, as the absence of steam does not alter the product, and the presence of steam, in the absence of the two other agents, does not produce it, we may safely put the steam out of the question.

2. Lime Soap. Complainant's witness, Professor Booth, heated lime soap with fat to 320° Fahr., for 8 hours, and found that no fat acid was produced. (Complt's Testy., p. 735, Q. 603.)

Booth also boiled water, fat and lime soap, at 212° Fahr., for 8 hours, and found that no fat acid was produced. (p. 735.)

Chevreul boiled potash soap with fat and water at 212° for sixty hours, and found that no fat acid was produced. (Wayne, Deft.'s Testy., p. 846, xQ. 46.)

No fact or experiment can be shown, in which lime soap and fat, without the presence of water at a high temperature and pressure, produced any fat acids whatever.

The reasonable conclusion from these facts is that lime soap is not the active efficient agent.

3. Water. Professor Booth heated fat and water to 320° Fahr., and a corresponding pressure, for 11 hours, and found 80 per cent. of fat acid in the product. He put it back and heated it for 13 hours more, and found it totally converted into fat acids. (Complt's Testy., p. 588, Q. 36.)

Water, at a high temperature and pressure, is, therefore, proved to be the active efficient agent; when it is present the result is *always* produced, when it is absent the result is *never* produced. It is the *sine qua non* of the operation.

Defendant's chemical experts do not pretend to offer a single fact to contradict this decisive *sifting* series of experiments.

They content themselves with experiments showing that the action of water is *not so quick* at 320° Fahr. when lime soap is absent, as when it is present; and therefore would have the Court believe that it is not the water, but something else, some "cata-

lytic action" which they can't define, or explain, or bring to the test of experiment, which is the real efficient agent.

They made these experiments:

1. They heated fat and water to 320° Fahr. for 3 hours, and found a barely perceptible "trace" of fat acid produced.

2. They heated fat and water to 320° Fahr. for 8 hours, and found from 10 to 13 per cent. of fat acid produced. *They used a narrow tube, held vertically and shaken once for 20 seconds in each hour.*

The "*mixture*"—"*intimate mixture or emulsion*"—so often and strongly insisted on in the patent as important for the *quickness* of the action, was here *entirely neglected*, or what is worse, mere pretense made of it.

3. They heated fat and water to about 320° F. for eight hours in Defendant's digester, and found ten to eleven per cent. fat acid produced (Deft's Test'y., p. 800.)

The materials were heated and mixed by a single jet of steam introduced at the bottom and pointing upwards. This would cause a general circulation of the liquids; the water in large waves would be thrown upwards into the supernatant layer of fat, and would then escape sideways and fall to the bottom. But as there was no means taken to divide or break up this mass of water into small particles, it could never become *intimately* mixed with the fat. Still this constant agitation was much better than the "twenty seconds in each hour" of the former experiment, and would doubtless have produced a much higher result, had there not been an agency at work actually *carrying off* the fat acid, nearly as fast as it was produced.

Scharling's experiment (Deft's Exhibit 12) proves that whenever free fat acid is mixed with neutral fat, as in the palm oil of commerce (which contains from one-third to one-half—Smith, p. 825), a current of steam passed through it at 320° F. will rapidly distill off and carry away the free fat acid in the state of vapor, and leave behind the neutral fat.

Now, Dr. Smith says that in his experiment (p. 799) "the valve of the digester was constantly blowing off immense quantities of steam." This steam at 320° F. must have been constantly carrying off part of the fat acid which had been previously produced by the action of the water, so that the ten or eleven per cent. found

Defendant's witness, Grant, says he has heated more than a million pounds of fat to 350° Fahr., with currents of steam heated to 800° passing through it, and the fat remained neutral. (Deft.'s Testy., pp. 925–6)

Defendant's witness, Verdin, says that the fat treated by steam in Wilson's tank process, which goes up to 100 pounds pressure, 338° Fahr,, remains neutral fat. (Deft's Testy., pp. 785–6.)

Therefore, as the absence of steam does not alter the product, and the presence of steam, in the absence of the two other agents, does not produce it, we may safely put the steam out of the question.

2. Lime Soap. Complainant's witness, Professor Booth, heated lime soap with fat to 320° Fahr., for 8 hours, and found that no fat acid was produced. (Complt's Testy., p. 735, Q. 603.)

Booth also boiled water, fat and lime soap, at 212° Fahr., for 8 hours, and found that no fat acid was produced. (p. 735.)

Chevreul boiled potash soap with fat and water at 212° for sixty hours, and found that no fat acid was produced. (Wayne, Deft.'s Testy., p. 846, xQ. 46.)

No fact or experiment can be shown, in which lime soap and fat, without the presence of water at a high temperature and pressure, produced any fat acids whatever.

The reasonable conclusion from these facts is that lime soap is not the active efficient agent.

3. Water. Professor Booth heated fat and water to 320° Fahr., and a corresponding pressure, for 11 hours, and found 80 per cent. of fat acid in the product. He put it back and heated it for 13 hours more, and found it totally converted into fat acids. (Complt's Testy., p. 588, Q. 36.)

Water, at a high temperature and pressure, is, therefore, proved to be the active efficient agent; when it is present the result is *always* produced, when it is absent the result is *never* produced. It is the *sine qua non* of the operation.

Defendant's chemical experts do not pretend to offer a single fact to contradict this decisive *sifting* series of experiments.

They content themselves with experiments showing that the action of water is *not so quick* at 320° Fahr. when lime soap is absent, as when it is present; and therefore would have the Court believe that it is not the water, but something else, some "cata-

lytic action" which they can't define, or explain, or bring to the test of experiment, which is the real efficient agent.

They made these experiments:

1. They heated fat and water to 320° Fahr. for 3 hours, and found a barely perceptible "trace" of fat acid produced.

2. They heated fat and water to 320° Fahr. for 8 hours, and found from 10 to 13 per cent. of fat acid produced. *They used a narrow tube, held vertically and shaken once for 20 seconds in each hour.*

The "*mixture*"—"*intimate mixture or emulsion*"—so often and strongly insisted on in the patent as important for the *quickness* of the action, was here *entirely neglected*, or what is worse, mere pretense made of it.

3. They heated fat and water to about 320° F. for eight hours in Defendant's digester, and found ten to eleven per cent. fat acid produced (Deft's Test'y., p. 800.)

The materials were heated and mixed by a single jet of steam introduced at the bottom and pointing upwards. This would cause a general circulation of the liquids; the water in large waves would be thrown upwards into the supernatant layer of fat, and would then escape sideways and fall to the bottom. But as there was no means taken to divide or break up this mass of water into small particles, it could never become *intimately* mixed with the fat. Still this constant agitation was much better than the "twenty seconds in each hour" of the former experiment, and would doubtless have produced a much higher result, had there not been an agency at work actually *carrying off* the fat acid, nearly as fast as it was produced.

Scharling's experiment (Deft's Exhibit 12) proves that whenever free fat acid is mixed with neutral fat, as in the palm oil of commerce (which contains from one-third to one-half—Smith, p. 825), a current of steam passed through it at 320° F. will rapidly distill off and carry away the free fat acid in the state of vapor, and leave behind the neutral fat.

Now, Dr. Smith says that in his experiment (p. 799) "the valve of the digester was constantly blowing off immense quantities of steam." This steam at 320° F. must have been constantly carrying off part of the fat acid which had been previously produced by the action of the water, so that the ten or eleven per cent. found

in the fat at the end of eight hours, was not the *whole quantity produced* by the action of the water, but only the *residue*, or that part of it which had not been distilled off and carried away by the steam.

Nearly as fast as the water produced fat acid the steam was carrying it away; there was, in effect, a race between the decomposing power of the water producing it, and the distilling power of the steam carrying it off.

The mixture or circulation of the fat and water caused by the steam ought certainly to have increased the result much above that of the first experiment, but, on the contrary, it was actually less—ten or thirteen per cent. with *no mixture*, and ten or eleven per cent. *with mixture*, showing clearly that something was carrying away the fat acid.

Now both these experiments are plainly imperfect and unfair in the conditions most important for rapidity of action or quickness of decomposition, yet this is the precise point they were intended to prove, and as to which Defendant's experts pretend to reason and calculate from them.

They first omit the essential requisites of quickness, and then exclaim, see how slow it is!

And their logic and arithmetic are as false as their experiments are unfair.

In three hours they get no notable quantity, a mere trace; in five hours more they get ten to thirteen per cent.; this plainly shows an increasing rapidity, and anyone really wishing to ascertain the facts, would have tried the effect of another period of five hours, and so on, step by step, until the decomposition was complete.

But these gentlemen, though engaged for several months in the investigation, never made this simple and obvious experiment.

They profess to want to find out how long a time is required for complete decomposition with water alone, at 320° F. Well—try the experiment.

Oh no, we will try it only just long enough to show that the decomposition has fairly started, and then we will stop and "calculate;" and how do they calculate?

In 3 hours the quantity decomposed is inappreciably small, in the next five hours it is ten to thirteen per cent., therefore, they

calculate another period of *eight* hours will be required to produce another ten or thirteen per cent., which they had just obtained in *five* hours; and so they go on calculating with their false-factor *eight* instead of *five*, and arrive at the conclusion that eighty hours would be required.

Using the correct figure five, even their own unfair experiments cannot make out the time necessary to produce defendants 60 per cent. of free fat acids, to be longer than 4½ or 6 periods (according as we adopt ten or thirteen per cent.) or five hours each, plus the three hours necessary to start the action, or 26 to 33 hours in all, which is about the average time actually employed by Defendant Werk as stated in his answer, (16 to 34 hours.)

To this tissue of fallacies of Defendants' experts we have to oppose Professor Booth's uncontradicted experiment, proving a decomposition of 80 per cent. in 11 hours, and a total decomposition in twenty-four hours.

And his results are strongly corroborated by the five sets of factory operations, at heats gradually rising by small successive steps of 20° or 30° F., above the 406° F. used by Defendants, (see table p. 586.) The Antwerp factory using water alone at a temperature but 356° F., get perfect decomposition in six hours. This is Defendants' own exhibit.

It is to be observed that Professor Booth's experiments were made ten years ago, and not for the purpose of this case. His attention was not then directed to ascertain the *shortest* time in which the decomposition could be effected by water alone at 320° F.

In the former suit the Defendants denied that water had any action whatever at 320° F., and their present expert, Wayne, then testified (Record p. 492), that a heat of 550° to 650° F., was necessary for that purpose.

Booth having obtained 80 per cent. in 11 hours, put his product back and continued the operation 13 hour longer without intermediate examination. His experiment shows 24 hours to be the *maximum*, but proves nothing as to the minimum.

The fallacy of their whole argument on this point, consists in confounding two things essentially different.

The existence, the *necessary existence*, of the action of water at a high temperature and pressure to the production of the free fat acids in Defendants' product, is the one question in this case.

The *quickness or slowness* of Defendant's *mode* of using that action, is a wholly different question, with which we have nothing to do.

If Defendants have invented a better mode of using Plaintiff's process, let them patent their improvement, but such invention gives them no right to use the original process.

The increased quickness of action when lime is used, is the consequence of its tendency to form an *emulsion* between the oil and the water. Appellees' expert, Wayne, says (p 846 xQ. 45), that when he mixed 4 per cent. of lime with oil and water "an emulsive mass of oil, lime and water took place," and (p. 864,) he says, that when lime is used, the lime, soap, fat and water were mixed in a homogeneous mass like thin mortar; but when no lime was used, the fat and water separated from each other.

It is a very striking coincidence, that the quickening effect of lime, according to the calculation of Defendants' expert, Smith, is *precisely the same in amount*, as the quickening effect of intimate mechanical mixture, as found by their expert, Verdin.

Smith says, (p. 800,) that to produce fat 60 parts of the acid in Defendants' product, with 8 hours is sufficient, but without lime, six times as long is necessary.

Verdin says (p. 781) that using fat and water alone at 180 lbs., with intimate mixture, 8 hours is sufficent, but without mixture, six times as long is necessary.

Now, though it is not expressly announced in Complainant's patent, that the presence of a small quantity of alkali quickens the decomposing action of the water, yet such a result is a natural and obvious consequence from the facts and principles there laid down.

"Intimate mixture, or *emulsion*," is directed, and the "quickness and perfection of the decomposition" is stated to depend upon the intimacy of the mixture.

Therefore any known familiar method of promoting "emulsion" will evidently promote quickness of decomposition.

Now, the addition of alkali had long been a known familiar method of promoting emulsion, and is so described in standard technical works. (Proctor's Pharmacy, p. 488.)

The use of a small quantity of alkali, recommended in the patent for an entirely different purpose, would necessarily have the additional incidental effect of promoting emulsion and quickness of decomposition.

It is to be remarked that up to this day no one has pretended to announce or claim this quickening action of alkali, or soap, as a new fact or discovery, although Defendants would have us believe that it is the most important point in the whole process.

De Milly's patent, (Record 278) neither states the fact, nor founds any claim upon it. He pretended that it was the alkali, or soap, that did the whole work of decomposition, but nowhere states whether it would do it faster or slower than water alone.

Werk in his Patent of 1858, (Record p. 437) is equally silent as to this.

Complainant's licensees use a little lime, or omit it as they choose, and their right to use it has never been questioned.

Its advantage is simply a balance between the cost of some extra fuel on one side, and that of the lime and acid on the other. Mitchell, of New York, Price & Co., of London, the Antwerp Factory, Sarg, near Vienna, and the Soap Manufacturing Company of Vienna, (Report of Exhibition of 1862, Compt's Testy, p. 743), still prefer to use water alone.

It yet remains an open question among manufacturers whether there is any advantage in it or not.

Defendants' counsel having obtained their eighty hour period, by the peculiar methods of experiment and calculation of their experts, proceed to assert, that such a long operation would make Complainant's process unprofitable—and if unprofitable, then impracticable and useless, and consequently his patent is void.

Not a word of proof exists as to what would be the cost of an operation of eighty hours, as compared with the saving of lime and acid. Werk found it profitable to continue his operation for 34 hours to save 6–10 of the lime and acid, and is willing to stand a suit to maintain their right to do so.

DISCUSSION OF LEGAL QUESTIONS AS TO SCOPE OF TILGHMAN'S PATENT, ITS VALIDITY AND INFRINGEMENT.

It is argued for appellees that the claim of appellant's patent, if construed to cover all degrees of high temperature and pressure, and all forms of apparatus, is a claim for a principle, and is, therefore, invalid under the decision in O'Reilly *vs.* Morse, 15 Howard, 62, and hence the Court must limit it to his patented apparatus.

A full consideration of that decision, and the facts upon which it was based, as stated by Chief Justice Taney, will show a radical distinction between the two cases, and that O'Reilly *vs.* Morse, as well as Neilson *vs.* Harford, which Chief Justice Taney cites and approves, are authorities in favor of the patentability of Tilghman's claim construed in its broad sense.

"It is impossible to misunderstand the extent of this claim. He "claims the exclusive right to every improvement where the mo- "tive power is the electric current, and the result is the marking "or printing intelligible characters, signs or letters at a distance. "If this claim can be maintained, it matters not by what *process* "or machinery the result is accomplished. * * * * "In fine he claims an exclusive right to use a manner and *process* "which he has *not* described and *indeed has not prevented*, and "therefore could not describe when he obtained his patents. The "Court is of opinion that the claim is too broad and not warranted "by law. * * * * * * * * * *

"The leading case upon this patent is Neilson *vs.* Harford, in "the English Court of Exchequer. It was elaborately argued and "appears to have been carefully considered by the Court. The "case was this: Neilson in his specification described his invention "as one for the improved application of air to produce heat in "fires, forges and furnaces, where a blowing apparatus is required. "And it was to be applied as follows: The blast or current of air "produced by the blowing apparatus was to be passed from it into "an air vessel or receptacle made sufficiently strong to endure the "blast, and through or from that vessel or receptacle, by means of "a tube or pipe, or aperture, into the fire, the receptacle to be kept "artificially heated to a considerable temperature by heat exter- "nally applied. He then describes in *rather general terms the* "*manner in which the receptacle might* be constructed and heated "and the air conducted through it to the fire, stating that the *form* "*of the receptacle was not material, nor the manner of applying heat* "*to it.* In the action above mentioned for the infringement of this "patent, the defendant, among other defences, insisted that the "machinery for heating the air and throwing it hot into the fur- "nace, was not sufficiently described in the specification, and the "patent void on that account. *And also that a patent for throwing* "*hot air* into a furnace, *instead of cold*, and thereby increasing the "intensity of the heat, was a patent for a principle and that a prin- "ciple was not patentable. Upon the first of these defences the "jury found that a man of ordinary skill and knowledge of the sub- "ject looking at the specification alone, could construct such an "apparatus as would be productive of a beneficial result, sufficient "to make it worth while to adapt it to the machinery in all cases

"of forges, cupolas, and furnaces, where the blast is used. And "upon the second ground of defence, Baron Park, who delivered the "opinion of the Court, said:

"It is very difficult to distinguish it from the specification of a "patent for a principle, and this at first created in the minds of the "Court much difficulty; but after full consideration, we think that "the plaintiff does not merely claim a principle, but a machine em-odying a principle, and a very valuable one. We think the case "must be considered as if the principle being well-known, the plain-"tiff had first invenied a mode of applying it by a mechanical ap-"paratus to furnaces, and his invention then consists in this, by in-"terposing a receptacle for heated air between the blowing appa-"ratus and the furnace. In this receptacle he directs the air to be "heated by the application of heat externally to the receptacle, and "thus he accomplishes the object of applying the blast, which was "before cold air, in a heated state to the furnace.

"We see nothing in this opinion differing in any degree from "the familiar principles of law applicable to patent cases. *Neilson "claimed no particular mode of constructing the receptacle or of "heating it.* He pointed out *the manner in which it might* be done, "*but admitted that it might also* be done in a variety of ways, and "*at a higher or lower temperature*, and that all of them would pro-"duce the effect in a greater or less degree, provided the air was "heated by passing through a heated receptacle. * * *

"Undoubtedly the principle that hot air will promote the igni-"tion of fuel better than cold, was embodied in this machine. But "the patent was not supported because this principle was embodied "in it. * * * But this patent was supported because "he had invented a mechanical apparatus, by which a current of "hot air instead of cold could be thrown in. And this new method "was protected by his patent. The *interposition of a heated re-"ceptacle in any form* was the novelty he invented. * * * And "his claim, as the patent was construed and supported by the "Court, is altogether unlike that of the patentee before us. Mr. "Neilson *discovered* that by interposing a *heated receptacle* between "the blower and the furnace, and conducting the current of air "through it, the heat in the *furnace was increased*, and this effect "was always produced, whatever might be the form of the recep-"tacle or the mechanical contrivances for heating it, or for passing "the current of air through it, and into the furnace."

"*But Prof. Morse has not discovered* that the electric or galvanic "current will always print at a distance, no matter what may be "the form of the machinery or mechanical contrivances through "which it passes. To produce that effect, it must be combined "with and passed through, and operate upon certain complicated "and delicate machinery, adjusted and arranged upon philosophical

"principles, and prepared by the highest mechanical skill. And it "is the high praise of Prof. Morse that he has been able by a new "combination of known powers, of which electro-magnetism is one, "to discover a method by which intelligible marks or signs may be "printed at a distance. *And for the method and process thus dis-* "*covered*, he is entitled to a patent. But he has not discovered that "the electro-magnetic current used as motive power in any other "method and with any other combination will do as well."

Now, to make Tilghman's case similar to Morse's 8th claim, it will be necessary to prove that the fact that highly heated water would decompose fats into fat acids and glycerine had been known to chemists for years before Tilghman's patent, and that it was generally believed that it could be successfully applied in practice, and that Tilghman was merely the first person to make and describe a machine by which it could actually be done.

If such were the facts, the Court might properly apply the rule in O'Reilly *vs.* Morse, and confine the patentee's claim to the machinery which he had invented to make a *previously known power* useful in practice.

As the facts really stand, however, Tilghman being the *first to discover the power* of water at a high temperature and pressure to convert fats into fat acids and glycerine, and also the first to propose to apply it to practice, and to describe a machine for doing it, saying at the same time that other forms of machine could be used, the case becomes exactly parallel to Neilson's, as stated by Chief Justice Taney.

The *method or process* of heating fat and water to a high temperature and pressure so as to produce fat acids and glycerine, becomes Tilghman's invention, and will be protected, no matter what form of machine be used to carry it out.

In Corning *vs.* Borden, 15 Howard, 267, Judge Grier says:—

"A process *eo nomine* is not made the subject of a patent in our "act of Congress. It is included under the general term, 'useful "art.' An art may require one or more processes in order to pro- "duce a certain result or manufacture. The term 'machine' in- "cludes every mechanical device or combination of mechanical "powers and devices to perform some function or to produce a cer- "tain effect or result. But where the result or effect is produced by "chemical action, by the operation or application of some element "or power of nature, or of one substance to another, such modes, "methods, or operations, are called *processes*. A new process is "usually the result of a discovery—a machine of invention. The

"arts of tanning, dyeing, making water-proof cloth, vulcanizing "India rubber, smelting ores, and numerous others, are usually car- "ried on by processes as distinguished from machines. One may "discover a new and useful improvement in the process of tan- "ning, dyeing, &c., *irrespective of any particular form of machinery "or mechanical device.* And another may invent a labor-saving "machine, by which the operation or process may be performed, and "each may be entitled to his patent. As for instance: A has dis- "covered that by exposing India rubber to a certain degree of "heat, in mixture or connection with certain metallic salts, he can "produce a valuable product or manufacture; he is entitled to a "patent for his discovery, *as a process or improvement in the art "irrespective of any machine or mechanical device.* B, on the con- "trary, may invent a new furnace, or stove, or steam apparatus, by "which this process may be carried on with much saving of labor "and expense of fuel, and he will be entitled to a patent for his "machine as an improvement in the art. Yet A could not have a "patent for a machine, nor B for a process, but each would have a "patent for the means or method of producing a certain result or "effect, and not for the result or effect produced."

In Household Co. *vs.* Neilson, Webster's Patent Cases, 683, the Court says:—

"It is quite true that a patent cannot be taken out solely for "an abstract philosophical principle; for instance, for any law of "nature, or any property of matter, apart from any mode of turn- "ing it to account in the practical operations of manufacture or "the business and arts and utilities of life. The mere discovery "of such a principle is not an invention, in the patent law sense of "the term. Stating such a principle in a patent may be a pro- "mulgation of the principle, but it is no application of the prin- "ciple to any practical purpose; and without that application of "the principle to a practical object and end, and without the "application of it to human industry, or to the purposes of human "enjoyment, a person cannot in the abstract appropriate a principle "to himself. But a patent will be good, though the subject of the "patent consists in the discovery of a great, general, and most "comprehensive principle in science or law of nature, if that prin- "ciple is by the specification applied to any special purpose, so as "thereby to effectuate a practical result and benefit not previously "attained. The main merit, the most important part of the in- "vention, may consist in the conception of the original idea, in "the discovery of the principle in science, or of the law of nature, "stated in the patent, and little or no pains may have been taken "in working out the best manner and mode of application of the "principle to the purpose set forth in the patent.

"But still if the principle is stated to be applicable to any "special purpose, so as to produce any result previously unknown, "in the way and for the objects described, the patent is good. It "is no longer an abstract principle. It comes to be a principle "turned to account, to a practical object, and applied to a special "result.

"It becomes, then, not an abstract principle, which means a "principle considered apart from any special purpose or practical "operation, but the discoverer's statement of a principle for a spec- "ial purpose; that is, a practical invention, a mode of carrying a "principle into effect. * * This is a question of law, and I must "tell you distinctly that this generality of claim,—that is, for all "modes of applying the principle to the purpose specified, accord- "ing to or within a general statement of the object to be attained, "is no objection whatever to the patent. That the application or "use of the agent for the purposes specified may be carried out "in a great variety of ways, only shows the beauty and simplicity "and comprehensiveness of the invention."

"I state to you the law to be, that *you may obtain a patent for "a mode of carrying a principle into effect;* and if you suggest and "discover not only the principle, *but suggest and invent how it may "be applied to a practical result by mechanical contrivance and appa- "ratus, and show that you are aware that no particular sort or modi- "fication of form of apparatus is essential in order to obtain benefit "from the principle, then you may take your patent for the mode of "carrying it into effect, and are not under the necessity of describing "and confining yourself to one form of apparatus.* If that were "necessary, you see what would be the result. Why, that a pat- "ent could hardly ever be obtained for any mode of carrying a "newly discovered principle into practical results, though the most "valuable of all discoveries, for the best form and shape and modi- "fication of apparatus cannot, in matters of such vast range, and "requiring observation on such a great scale, be attained at once. "Hence, you may generally claim the mode of carrying principle "into effect by mechanical contrivance, so that any sort of apparatus, "applied in the way stated, will, more or less produce the benefit, "and you are not tied down to any form."

The point that Tilghman's claim involved a patent for a principle, was fully argued before Judges McLean and Leavitt in the suit of Tilghman against Werk, and the opinion of the Court, (Record p. 554,) disposes of it in accordance with the authorities above cited.

The fact that Judge McLean, who agreed with Judge Leavitt in sustaining the validity of Tilghman's patent, was one of the majority of the Supreme Court which rejected Morse's 8th claim, gives additional weight to his decision on this point.

Tilghman having made the discovery that water when heated and retained in a liquid state by pressure in a close vessel to prevent its escaping as steam, possessed certain chemical powers with reference to fat, did not stop there.

He went on to find out how this principle might be made practically useful. The first thing was to discover by experiment how much water was necessary, and he announces in his patent that from one-third to one-half of the bulk of the fat will produce the result.

The next thing was to discover the degree of heat, and length of time, and he naturally sought to do it in the shortest time, and he found by experiment, and announces in his patent, that the higher the temperature the more powerful is the action, and that at the temperature of about 612° F., the action will take place in ten minutes.

In the case of Mowry *vs.* Whitney, the language used in the Whitney patent in describing his process was that "the temperature of the Furnace or chamber, and its contents are gradually raised to a point a *little below* that at which *fusion commences* when, etc." 14 Wallace, p 626.

This was the *only instruction* as to temperature given in that patent. The defendant relied on two points in opposition to that claim in the specification:

1. "That Whitney's patent is void, because that which is described and claimed therein is not useful, inasmuch as it designates and provides for such a degree of reheating and none other ('*a little below that at which fusion commences*'), as will destroy the chilled periphery or tread—an essential feature to a car wheel."

2. "That Mowry's process does not infringe on Whitney's patent, because it is incredible (that in the Mowry process), any such degree of reheating is or could result as is contemplated in Whitney's patent." 14 Wallace, 636.

Upon these points this Court, per Mr. Justice Strong, says:

"The validity of the invention is next assailed for the reason "that the process described in it, and claimed, is denied to be use-"ful, because it would destroy the hardness of the rim, or tread of "the car wheel, known as the chill, and thus greatly detract from "the durability and usefulness of the wheels.

"It is undoubtedly true that a chilled periphery or tread is "essential to the usefulness of a car wheel. Indeed, the evidence

"is, that whenever car wheels are spoken of, wheels with chilled "tread are meant, and any process which destroys the chill must "render them valueless for the purpose for which they are "needed.

"It is also true that the fusing point of cast-iron is in the neigh- "borhood of 2786 degrees of Fahrenheit, twelve or fifteen hundred "degrees above the point at which, according to the evidence, the "chill of the tread of a car wheel would be destroyed. If, there- "fore, the process patented to Whitney, requires, after the removal "of the wheel to the heated furnace or chamber, the application of "a degree of heat closely approximating the point of fusion, it must "be conceded that instead of being beneficial it is positively hurt- "ful. And this is what is contended by the appellant. The objec- "tion seems to be aimed at the sufficiency of the description of the "patentee's invention, which it is abundantly proved he practiced "successfully through many years, rather than at its utility. Whit- "ney conceived a process and practiced it. * * * *

"Then the avowed purpose of the inventor has been accom- "plished. It would be most unreasonable to read the directions "of the specification without reference to the object which they "profess to have in view. The evidence is that the chill is formed "while the casting is in the mold, and that the hurtful strains com- "mence after the formation of the chill. Indeed it is manifest there "can be no strain until the chill is complete. It must be, therefore "that all the heat which is needed to relieve from the strain is that "which suffices to raise the temperature of the thin part, or plate, "to the degree at which the strain commenced—a lower temper- "ature than that which existed when the chill was formed. Hence "an operator, in following the directions of the specification, would "be taught by his practical knowledge that the instant all parts of "the wheel had been heated to that temperature, no more heat "was needed.

"And we do not think it a fair construction of the patentee's "language to hold that it requires the heat to be raised in all cases "to a degree only a little below the point of fusion. He does not "attempt to give any more definite direction than that all parts of "the wheel must be raised to the same temperature, suggesting in "a parenthesis, ("say, a little below that at which fusion commen- "ces.) He fixes a maximum. The heat must not reach the point "of fusion, and the prescribed minimum is that degree where the "heat of the different parts of the wheel is equal. Within those "limits the degree is left to the judgment of the operator, and "within those limits it is clear from the evidence that the process "may be applied without injury to the chill. The proof is that it "has been successfully applied in the manufacture of a vast num- "ber of wheels, and that failure has been very rare. 14 Wallace "Rep., 644.

ARGUMENT FOR APPELLANT IN REPLY.

PRIOR STATE OF ART.

I.—DECOMPOSITION OF FAT BY SOAP MAKING.

Fat exists in nature in the form of minute globules disseminated among the tissues of the animals and vegetables producing it. To separate it in a commercial form heat and pressure are used for vegetable tissues as in linseed oil mills.

The fat cells always present a nearly spherical form (as shown at *a a* in the figure), their intervals are traversed by a minute network of blood-vessels from which they derive their secretion—*b b* are fibres of areolar tissue.

Fatty tissue of animals of which the microscopic appearance is given in the cut, cannot be broken up by pressure; but when heated so as to expel all its water, the animal tissue contracts and shrivels up at the same time that the fat globules are much expanded so that the cells burst and the fat flows out in a liquid mass. This process is called "rendering" and the shrivelled animal tissue left after the fat is removed is called the "cracklings"; this process produces a very offensive smell and wastes considerable fat in the cracklings; when fat is boiled with water, a portion of the animal tissue is dissolved and a corresponding portion of fat is "rendered," but it is too slow and incomplete a process for practice.

In 1823, Appert patented, in France, the process of rendering fat in a closed boiler with water, so that its heat is raised to 266° F., in place of 212°, as in open vessels. This increase of temperature so increases the solvent power of the water for the animal tissue that it is entirely dissolved and all fat obtained. This process of Appert's has been extensively used, and has been repeated over and over again in various forms for rendering and purifying fats and oils, and will be frequently presented in the exhibits of this case.

Fats obtained from various sources differed much in hardness and fusibility, and each variety was formerly supposed to be an entirely different article. About 1816, Braconnot, a French chemist, discovered that they were mere mechanical mixtures, in various proportions, of fats entirely solid and hard, now called stearine, with an entirely fluid fat or oil. He found that simple pressure, very slowly applied, separated the fluid part and the remainder made hard candles; but the process was difficult and imperfect.

Chevreul, in 1825, discovered that fats were compounds of a substance called glycerine, with a fatty body, having slight acid characters called fatty-acids; that when fats were deprived of this glycerine the fatty acids could be rapidly and perfectly pressed and made the best possible material for candles, and he patented a process of obtaining these fatty acids. Record, p. 258.

His process consisted of two distinct stages:

1. The manufacture of the fat into *soap*, by the use of lime or other alkali—14 pounds of lime were used to 100 pounds of fat.

2. The decomposition of the soap so produced into fat acid by the use of two pounds of sulphuric acid to each pound of lime.

Soap had always previously been made by boiling the fat and solution of alkali together, and he suggested that this production of *soap* could be expedited by boiling the fat and the solution of alkali together *under pressure*. He made no suggestion or hint that *water alone*, heated and under pressure, would of itself decompose neutral fat into fat acid and glycerine.

That the invention of Chevreul is as above set forth, and is different from Tilghman's, is proved,

1. By admissions of appellees' witnesses.

APPELLEES' WITNESS, DR. SMITH. RECORD, p. 796.

Ans. 7. "The process applied to manufactural chemistry, and known under the general term of saponification of the fats, have been: *First*, by decomposition of the fats with alkalies, alkaline earths and other bases in conjunction with water and heat, either in open vessels or under pressure. This was first applied, in 1825, by Chevreul and Gay Lussac, and has been subjected to various modifications since."

SAME WITNESS. RECORD, p. 820.

Q. 119. "From the time of Gay Lussac and Chevreul's patent up to 1854, has it not been generally stated in chemical and technical works, that the direct product of the lime-saponification process was a lime-soap, meaning *thereby a neutral lime-soap*, or with an excess of lime?"

Ans. "It has been so understood."

APPELLEES' WITNESS, VAN DER WEYDE. RECORD, p. 176.

Q. 78. "Did Chevreul make free fat acids or a neutral soap by this saponification?"

Ans. "*He made a soap first*, in order to convert it afterwards into free fat acids."

2. Proved by testimony of appellant's witnesses:

PROFESSOR J. C. BOOTH. RECORD, p. 52.

"Exhibit 18," from "Certificates of Inventions," vol. 41, pages 392 and 393, January 5th, 1825, contains a part of the patent granted to Gay Lussac & Chevreul, for the application of stearic and margaric acids to illuminating purposes, in which they state the first process always to be, making a soap of the fat by acting on it with an alkali, potassa, or soda and subsequently separating the acid. They further state that the operation of soap making may be performed at ordinary temperatures and pressures, but that the operation of making soap at a more elevated temperature, with a pressure of several atmospheres, presents greater advantages. In complainant's "Exhibit AA," claiming to be part of the passage quoted in "Exhibit 18," the methods of decomposing the soap so as to get fat acids, and of separating the fluid acid from the solid acid, are stated. Plaintiff's process has nothing whatever to do with the making of soap from fats, but makes fat acids and glycerine from fats by the direct action of water."

PROFESSOR F. A. GENTH, Q. 9. RECORD, p. 89.

III. CHEVREUL & GAY LUSSAC.	III. TILGHMAN.
1. Produces a neutral soap by using enough alkali to saturate all the fatty acids contained in the fat.	Produces no soap.
2. Produces no free fatty acids directly.	2. Simultaneously produces free fatty acids and a solution of glycerine, by the direct action of highly heated water upon fat.
3. Produces soap, both at ordinary and elevated pressure.	3. Elevated pressure indispensable.

PROFESSOR BOOTH. RECORD p. 609.

APPELLEE'S EXHIBITS.	APPELLANT'S PROCESS.
Roret (*Exhs. 4 and* 5), *Gay Lussac & Chevreul* (*Exh. 6*), *Radley & Meyer* (*Exh.* 10).	
Make neutral lime soap either in open or closed vessels.	Produces no soap.
Do not make free fat acid.	Makes free fat acid.
Lime is the chemical agent which decomposes the fat.	Highly heated water is the chemical agent which decomposes the fat.

PROFESSOR ROGERS. RECORD p. 676.

Q. 48. Examine Defendants' Exhibit No. 6 (Chevreul's patent), and state whether it contains any evidence of a prior knowledge or use of the process patented to Complainant.

A. It contains no such evidence; it refers exclusively to the making of *soaps* either in open or close vessels.

II.—DECOMPOSITION BY SULPHURIC ACID DISTILLATION.

The sulphuric acid distillation process was invented and used for producing *fat acid only*, and not glycerine; the glycerine being *destroyed* by the process. This process differed from Tilghman's.

1. In the result produced—fat acid only, while Tilghman's produced simultaneously both fat acid and glycerine.

2. It required sulphuric acid to decompose the fat into fat acid.

3. It did not depend for its efficiency on the use of highly heated water under pressure.

4. It was a process of distillation.

DEFENDANT'S WITNESS, DR. SMITH. RECORD p. 796.

Q. 7. *Fourthly*, by heating the fat with sulphuric acids (containing two equivalents of water), and by subsequent distillation, the fat acids are obtained and the glycerine destroyed. It has been carried on successfully and extensively since about 1846.

JOURNAL OF SOCIETY OF ARTS, LONDON, 1855. PAPER BY G. F. WILSON, VOL. 3, p. 729. (COMPLAINANT'S TESTIMONY, RECORD 106.)

"By our first improvement in separating the fat acids from neutral fats, the glycerine was decomposed by the direct action of concentrated sulphuric acid at a high temperature, and all that remained of it was a charred precipitate."

APPELLEE'S WITNESS VERDIN, SR., RECORD p. 157.

Q. 9. What is the method by distillation?

Ans. We saponify the fat, first with sulphuric acid, and wash the sulphuric acid out afterward with hot water. That water takes out the glycerine and the sulphuric acid, and then from there take it and put it in the still, and distil it over by fire and steam, and then condense it, and then let it off as fatty acids.

APPELLEE'S WITNESS, JOHN H. SMITH, RECORD p. 233.

Q. 2. Before the distillation is commenced in that process, state whether the glycerine contained in the fat is previously destroyed or removed, and by what means?

Ans. We suppose it is destroyed by acidification of the fats by sulphuric acid.

Q. 3. State whether this is before the distilling parts of the process commences?

Ans. It is.

The above two processes, viz: Chevreul's lime soap process, and the sulphuric acid distillation process, were the only processes practically used down to the time of Tilghman's invention, as proved by defendant's witness.

WAYNE, DEFENDANT'S TESTIMONY, p. 863.

Q. 156. Were any process for manufacturing fat acids practically worked as a manufacturing operation prior to 1854, except the lime saponification process, and the process of sulphuric acid combined with distillation?

Ans. Not that I know of.

Q. 157. In the process by sulphuric acid combined with distillation, was the glycerine destroyed?

Ans. It was.

MITCHELL'S FOREMAN, VERDIN, JR., RECORD p. 226.

XQ. 168. From all your reading and your experience in factories, can you say that any mode of decomposing fats was practically employed in a stearine candle factory prior to the date of Mr. Tilghman's patent, January, 1854, except the process of lime saponification or sulphuric acid distillation process?

Ans. I can not.

III.—ATTEMPTED DECOMPOSITION BY STEAM.

It was from time to time attempted, prior to Tilghman, to decompose neutral fat into fat acid by distillation in a current of steam, but

1. It was an unsuccessful and abandoned experiment, and never came into use.

2. Even if it had been successful it differed in every way from the process of Tilghman, thus:

a. It differed in not producing glycerine as a result.

b. It differed in not depending upon, or even allowing of, the presence of highly heated *water* under pressure.

c. It was a process depending on vaporization and subsequent condensation of the fat.

d. The apparatus absolutely *necessary* for the distillation process was such as to render the execution of the hot water process of Tilghman in the same utterly *impossible*.

1. The steam distillation process was an unsuccessful and abandoned experiment.

The persons chiefly relied upon by Appellant as using the steam distillation process were G. F. Wilson and Scharling and Dubrunfaut.

APPELLEE'S WITNESS, WAYNE, RECORD, p. 55.

Q. 108. Was the process of Scharling at the heat mentioned by him (320° F.), practically employed for manufacturing fat acids prior to 1854, as far as you know?

Ans. I cannot say that it was.

MITCHELL'S PARTNER AND WITNESS, VERDIN, SR., RECORD, p. 161.

X. 56. Do you know of any factory where fat acids and solution of glycerine were manufactured directly by distilling neutral fat in a current of steam, prior to January 9, 1854?

Ans. No.

MITCHELL'S FOREMAN AND WITNESS, VERDIN, JR., p. 216.

X. 60. Did you know of Scharling's process ever being tried or attempted to be tried by any one prior to April, 1864?

Ans. Not as to my personal knowledge.

Scharling tried it and says it would not be advantageous to obtain margaric acid (fat acid) from tallow for practical use; he says:

APPELLEE'S EXHIBIT 10, RECORD, p. 251.

"By treating tallow with super-heated vapors of water, a hard "crystalline mass was obtained, which consisted principally of "margaric acid. But the decomposition of the tallow in this man- "ner *took place so slowly, that it will not be advantageous to obtain "the margaric acid for practical use in this manner.*"

And Mitchell's principal witness, Verdin, Jr., admits that the statement of Scharling shows that it was an unsuccessful experiment, and would of itself induce a person to avoid this process.

RECORD, p. 225.

X. 157. Would not a person reading his paper be induced to conclude from the paper itself that he had better try some other mode of decomposing tallow than by using Scharling's own process?

Ans. I rather think yes.

PROF. ROBERT E. ROGERS, RECORD, p. 79.

"My conviction is, that in the special cases referred to by Scharling of results, the steam or vapor of water, did little if anything in setting free the fat acids, but simply aided in the volatilization of the fat acids already present in the so-called neutral fats."

DIRECT EXAMINATION RESUMED, RECORD, p. 79.

Q. 25. Does Scharling anywhere say that he obtained glycerine as well as fat acids by his distilling experiments; state also, where the glycerine would have been found, if he had produced any in said experiments?

Ans. He nowhere states that he produced glycerine in his experiment. Had he produced glycerine, it would have been found carried over with the vapor of water.

Q. 26. Would not any chemist making the chemical examination of the over distilled water, which he states he made in search of sebacic acid, have been certain to have found said glycerine, as a residue in the process, if any had existed there?

Ans. Glycerine is so marked in its properties, and so readily detected, that I cannot conceive it could fail to be recognized and spoken of by any one professing to be a chemist, should it actually

exist in the over distilled water, had it been present in it, in the case of Scharling's experiment. The omission to mention it on his part, I conceive clear evidence of its absence altogether.

G. F. Wilson states that the direct distillation of fats destroys or decomposes the glycerine, and that it was preferable to abstract or destroy the glycerine before attempting to distil. Extract from patent of Gwynne & Wilson, 1843, Appellant's Ex. 1000, Rec. p. 101.

"In the course of a series of experiments in which we have been engaged for some time past, relative to the distillation of fatty and oily matters, we have particularly observed that fats and oils in their natural state are not well adapted for distillation, owing, as it appears, to the presence of the ingredient called 'glycerine,' and that although fats and oils can be distilled in their natural state, and the distillation itself destroys or decomposes the 'glycerine,' it is a preferable mode of operation to abstract, destroy, or decompose the 'glycerine' in the first instance, and afterwards to submit the fatty or oily matters to distillation in the acidified or modified state produced by such action."

The steam distillation process did not depend upon or even allow the presence of highly heated water under pressure; the steam distillation apparatus and the apparatus for using highly heated water under pressure are of a directly opposite and incompatible character.

APPELLEES' WITNESS, DR. SMITH, RECORD p. 832.

Q. 194. In the process of Dubrunfaut, (Defts. Ex. No. 8), or in that of Scharling, (Defts, Ex. No. 12), or in that of Payen, (Defts. Ex. No. 8), is any liquid water, at a high temperature and pressure, present, mixed with the fat, during the operation?

Ans. There would appear to be no water present in a liquid form,

Q. 195. Could the process of defendants or of complainant be operated in the distillatory apparatus of Dubrunfaut, or of Scharling, or of Payen, referred to in cross-question 194, or could either of the three last named processes be operated in the apparatus of defendants or complainant?

Ans. The processes of both the complainant and defendants are different from the above, and could not be performed in the above apparatus, for both the complainant and defendants call for closed digesters, while the stills of Dubrunfaut and Scharling have open communication with the atmosphere.

APPELLEE'S WITNESS, WAYNE, RECORD p. 852.

Q. 84. In the process of Scharling, (Defts. Ex. 12,) is all the fat acid mentioned as having been produced by him, described as having been distilled and found in the condenser?

Ans. It is.

Q. 85. In said experiment of Scharling, is any liquid water described as having been mixed with the fat while the fat was at the temperature of 160° C. (320° F.)?

Ans. There is not.

Q. 86. In said experiment was any pressure above that of the atmosphere applied to the still?

Ans. No.

APPELLANT'S WITNESS, PROF. BOOTH, RECORD p. 600.

Q. 92. State whether the description of Dubrunfaut's process in Exhibit 8 contains any evidence of a prior knowledge or use of complainant's process, and explain wherein it resembles or differs from complainant's process?

Ans. It contains no such evidence, since it makes no mention of the manufacture of fat acid by the action of highly heated water. Dubrunfaut decomposes fats by a current of steam at a light temperature; plaintiff decomposes fats by a highly heated water. Dubrunfaut decomposes fats at ordinary pressure; the plaintiff decomposes fat at a high pressure. Dubrunfaut employs an open vessel; plaintiff employs a closed vessel. Dubrunfaut employs steam, or the vapor of water; plaintiff employs liquid water.

PROFESSOR BOOTH, RECORD p. 606.

Q. 124. Explain wherein Scharling's process, as described in Exhibit 12, resembles or differs from complainant's process.

Ans. In Scharling's process oils or fats are heated in an open vessel or still, and superheated steam passed through them. The fat acids are thus distilled over, and condensed in a cold receiver.

Scharling's process is essentially the same as Dubrunfaut's in defendant's Exhibit 8; it is merely carried on at a lower temperature and less rapidly, so that for tallow it is stated to be too slow for practical use. Scharling's process resembles complainant's only in one point, that they both produce fat acids. Scharling distills the fat acids; plaintiff does not distil them. Scharling's process requires open vessels; plaintiff's process requires close vessels. Scharling's process is performed without pressure; plaintiff's process requires pressure. In Scharling's process no liquid water is or can possibly be mixed with the heated fat. In plaintiff's process liquid water must necessarily be mixed with the heated fat. In plaintiff's process the glycerine is found dissolved in water. In Scharling's process no mention is made of the glycerine.

DEFENDANT'S WITNESS, VERDIN, JR., RECORD p. 216.

X. 28. In Scharling's process, why is there an absence of pressure?

Ans. Because the outlet of the vessel is larger than the pipe conveying the steam into it.

X. 30. Does not every process of distillation require the absence of pressure?

A. Yes, sir: the distillation process requires the absence of pressure.

VERDIN, JR., RECORD pp. 155-6.

X. 282. Can process of manufacturing fatty acids by the process of distillation in a current of steam be practically carried out, either in the apparatus described in Complainant's patent, or in the apparatus used in Defendant's factory.

Ans. No, sir.

X. 285. State whether the process of decomposing fats into fatty acids and solution of glycerine by the action of water at high temperature and corresponding pressure, as affected in the apparatus of both Plaintiff and Defendant, can be practically carried out in the apparatus made use of for distilling fats into fatty acids by the action of a current of steam.

Ans. They can not.

PROFESSOR WOLCOTT GIBBS, RECORD p. 28.

Q. 14. (Objected to.) Could the plaintiff's process be worked in the distillation apparatus described in Exhibit 4?

And could this distillation process be worked in Plaintiff's apparatus?

Ans. I answer no, to both branches of this question.

The state not only of the art, but *even of scientific knowledge* on the subject of attempted steam distillation of neutral fats, is fully shown by the report of the

EXPOSITION UNIVERSELLE DE 1855.

JURY REPORT,

pp. 495, 496, immediately preceding Defendant's exhibit, Record 910.

AQUEOUS SAPONIFICATION COMBINED WITH DISTILLATION.

"The researches of Chevreul having shown that the saponifica-
"tion of the fatty bodies is accomplished by the fixation of the ele-

"ments of water by the fat acids and glycerine which compose "them, it was very natural to search for means to affect this reac- "tion by the intervention of water only, and to combine it with "distillation. In the patent of June 9, 1825, granted to Moses "Poole, we see the distillation of the neutral fats, under the influ- "ence of heat and water, proposed for the first time. But it must "be remarked that the introduction of steam into the still, had for "its object 'to facilitate the evaporation.' As we have previously "remarked *it was optional.*

"All the chemists who have attempted to carry out the oper- "ations described in this patent, have acknowledged its correct- "ness; but all have also found that the production of fat acids is "accompanied by acroleine, the irritating properties of which, upon "the eyes, are such that no one can resist it.

"Gay Lussac, himself, was so convinced that in this distillation "it was not possible to prevent the decomposition of the glycerine "and the production of acroleine, that in 1828, in his course of lec- "tures he declared that the distillation of tallow 'could not be use- "ful in the arts,' (note Cours de Chimie de M. Gay Lussac, tome "11, 29 lecon (28 Juillet, 1838), p. 12.)

"M. Dubrunfaut resumed this subject. In his patent, which "we have already quoted from as to the distillation of fat acids, he "states as follows: * * * * * * *

(Here follows the extract from Dubrunfaut's French patent, which is translated and printed.) Record, pp. 247–48.

"The manufacturers who have tried to put in practice these di- "rections have been obliged to abandon this method of saponifi- "cation and distillation. In fact they cannot thus avoid the "production of acroleine, which greatly incommodes the work- "men.

"It was reserved for M. G. Wilson, of whom we have already "spoken, in relation to the sulphuric saponification combined with "distillation, to resolve this *great* and *difficult* problem. We say "difficult; it has appeared so to such a degree that before the jury "had obtained precise and indisputable information, the announce- "ment of the solution of the problem had been received with *donbt*, "not to say *entire disbelief.*

"But at present it is no longer possible to doubt. In fact, M. "Wilson has succeeded, by the aid of heat and water, to set free "simultaneously the fat acids and glycerine which compose palm "oil, and to cause, at the same time, the distillation of these acids "and the glycerine, so as to obtain all these products in a state of "chemical purity.

"On the 30th August, 1855, our learned colleague, M. Warren "de la Rue, visited the factory at Battersea, near London, and saw

"in full operation a still of the capacity of 6,362 quarts, and him-
"self took from the condensers samples of the fat acids and gly-
"cerine, in strong solution and pure. At that time there were
"three apparatus of the same capacity in the factory.

"M. Wilson has succeeded in determining with such precision
"the conditions under which glycerine volatilizes without altera-
"tion, that at this time, in the large factory we have mentioned, he
"is carrying on the rectification of this substance so as to put it in
"the market in a chemically pure state."

* * * "The distillation of the neutral fatty bodies
"requiring from twenty-four to thirty-six hours."

This successful result of Wilson's was subsequent to and suggested by seeing Tilghman's process in operation.

WILSON'S LECTURE DELIVERED BEFORE SOCIETY OF ARTS. RECORD, p. 113.

"I went with my chemist-assistant, Mr. Payne, to see Mr.
"Tilghman's little apparatus *at work*, and in the course of some
"experiments which it led us to try, or rather to try over again, it
"struck me that steam passed into the fat, at a high temperature,
"should effect by a gentle process what Mr. Tilghman aimed at
"effecting by a violent process, the resolving of the neutral fat into
"glycerine and fat acids. In July, 1854, we took out a patent for
"this process."

December 13, 1855, three months after M. Warren de la Rue had seen the three large stills working the steam distillation process, Wilson's Company obtained a license to work Tilghman's patent at £1,000 per annum. Record, p. 91.

July 20, 1857, said licencees (Price's Patent Candle Co.) have a large apparatus in successful use on Tilghman's patent (Record, p. 740), which, with one or more like it, remained in use when last heard from, July, 1865.

We maintain that the steam distillation of neutral fats, so as to decompose them into fat acids and glycerine, was never accomplished until Wilson did it after seeing Tilghman's patent at work, and even then it was found so slow, expensive and imperfect that it has never been more than a *mere chemical curiosity* at the inventor's own factory; and was practically abandoned as a manufacturing process even there in favor of Tilghman's process as soon as they purchased the right to use it. Not a single factory in the

world is asserted as working by this steam process of Wilson, although all the apparatus required is in daily use in every distillation factory.

APPELLEES' WITNESS, SMITH, A FAT ACID MANUFACTURER. RECORD, p. 237.

X Q. 68. Why have you not adopted this process of steam distillation *without the use of sulphuric acid* for obtaining fat acid and glycerine within the last five yearss?

A. Because we thought it would cost too much money.

X Q. 69. Was that the conclusion of the result of experiment?

A. No, sir.

X Q. 70. Why did you think it would cost too much money?

A. From the representations of other manufacturers.

X Q. 71. What manufacturers?

A. I am not bound to state, I believe; it was from a Boston gentleman.

X Q. 72. Was he a manufacturer, and what was his name, and in what way did you deem it too expensive?

A. He was a manufacturer. His name was Hawes, I think. I deemed it too expensive because the apparatus cost too much.

JOHN H. SMITH.

Defendants have endeavored to confuse Dubrunfaut and Scharling's process of distillation by *steam*, without *liquid water*, and without pressure, with complainant's process of decomposition with liquid water and a high pressure and temperature, by alleging that the chemical principle involved was the same in both, viz: that the elements of water were taken up by the elements of the fat, and thereby formed fat acids and glycerine.

This fallacy is clearly exposed by Professors Booth and Rogers, who show that for forty years past it has been received as the theoretical explanation of the formation of fat acids and glycerine, *in all cases*, that the elements of water were taken up by the elements of the fat, no matter whether the process used was saponification by alkali, or acidification by sulphuric acid, or distillation with steam.

The process, or means, employed to *compel* the fat to take up the elements of water is different in each case, but the theoretical explanation, or principle involved, is the same in all.

If to-morrow a person should discover that by acting on fat *with ice* at a low temperature, fat acids and glycerine would be

produced, it is certain that the theoretical explanation or principle involved would be, that the elements of water were taken up by the fat; but it is no less true that the chemical fact and any practical process founded thereon would both be new.

A knowledge of the theory or nature of a chemical change which we *desire to produce* is a very different thing from discovering how that change *can be forcibly produced.*

It is well known that it is only necessary to crystallize carbon in order to produce diamonds; nevertheless, a method by which carbon can be *compelled* to crystallize and produce diamonds, would be generally considered both as a new chemical fact, and a new and patentable manufacturing process.

PROOFS OF NOVELTY OF TILGHMAN'S PATENT.

Tilghman was the first to announce it, *even as a scientific fact,* that highly heated *water* under *pressure* would decompose neutral fats into fat acid and glycerine.

Admission by Appellees' witnesses.

MITCHELL, RECORD, p. 763.

Q. 99. When did you first see neutral fats decomposed into fat acids and glycerine by the use of highly heated water under pressure, knowing at the time that such a mode of decomposition could be used without the aid of chemicals?

Ans. I have known for more than forty years that fats were acidified by moisture. I never knew that the products mentioned, fat acids and glycerine, could be obtained from fats by heat, water and pressure, until I heard of it in connection with the patent of Wright & Fouché, about 1859. Several years prior to that date, the Complainant patented an entirely impracticable and worthless process, which never has been used because it cannot be, and the products obtained which he claims to produce, which I heard of previously to the date of the patent of Wright & Fouché's process.

Q. 100. When did you first employ highly-heated water under pressure, at your factory, to decompose neutral fat into fat acids and glycerine without the aid of chemicals?

Ans. It was sometime in 1860, in December of that year.

F. VERDIN, DEFENDANT'S DESTIMONY, RECORD p. 242.

XQ. 22. When did you first see it stated in a book or document that highly heated water under pressure would, without the aid of

chemicals, decompose neutral fat into fat acid and a solution of glycerine?

Ans. I don't know when.

XQ. 23. Can you swear you ever saw that statement prior to the date of Mr. Tilghman's patent, January, 1854?

Ans. I cannot.

SAME WITNESS, RECORD p. 786.

Q. 75. When did you first see neutral fat decomposed into fat acids and a solution of glycerine by the action of water at a high temperature and pressure, knowing at the time that such a decomposition had been effected?

Ans. I first saw it in 1859 or 1869, when Wright & Fouché sold their patent to R. G. Mitchell & Co.

Q. 76. Down to that time, what agency had you employed to effect this decomposition of neutral fats?

Ans. I had employed lime, from twelve to fourteen pounds to the one hundred pounds of fat, and sulphuric acid in proportion.

Q. 77. Why did you not, during all the time of your manufacturing prior to 1850, dispense with the use of lime and sulphuric acid, and substitute the use of highly-heated water under pressure?

Ans. Because I could not find a process better than the lime process, until Wright & Fouché introduced their process by the circulation of the water.

J. T. VERDIN, FOREMAN OF MITCHELL'S FACTORY, RECORD p. 216.

X. 53. Who was the first person who stated that there would be an advantage in decomposing fats into fat acids and glycerine by the use of highly-heated water retained in the liquid state by pressure and in the absence of lime?

Ans. I don't know of any one who said there would be an advantage in that.

X. 14. Who was the first person who stated that it was advisable to decompose fats in that way?

Ans. I think Mr. Tilghman was the first person to mention that fats would be decomposed by water at or about the melting point of lead; many before him have stated that water or its elements, without specifying any particular temperature, would do the same thing.

X. 55. Which of them, before Mr. Tilghman, stated that highly heated *water under pressure*, in absence of lime, would decompose fat into *fat acid* and *glycerine*, and quote the statement, and give the name of the person who made such statement?

Ans. I don't know of any one having stated it in that form.

APPELLEES' EXPERTS. PROF. VAN DER WEYDE, RECORD, p. 185.

X. 141. Please state who was the first person, within your knowledge, who made the explicit statement that fat acids and solution of glycerine could be obtained for manufacturing purposes by the action of liquid water on neutral fatty bodies, at temperatures above three hundred and fifty degrees Fahrenheit; and state when and where such statement was made. [Answer objected to as irrelevant to the question.]

X. 142. Question repeated and read over to the witness.

Ans. I have already in my answer stated that Mr. Tilghman, in his patent of 1854, made this statement; it reads thus: "I subject these fatty or oily bodies to the action of water, at a high temperature and pressure, so as to cause the elements of those bodies to combine with water, and thereby obtain at the same time free fat acids and solution of glycerine."

Appellee's scientific witnesses, Profs. Smith and Wayne, though very astute in suggesting (from their present knowledge) what *might have been* the unknown and unrecorded results of ancient experiments, and what chemists of those days *ought to have discovered* therefrom, are yet unable to point out any prior announcement of the chemical fact which forms the basis of complainant's patent—a fact so important, so easily and clearly defined, as to be impossible to be mistaken or overlooked.

DR. SMITH, RECORD p. 832.

Q. 197. Can you testify that you have ever seen any publication, of date earlier than January 9, 1854, in which it is explicitly mentioned that fats can be decomposed into free fat acids and glycerine by the action of liquid water at a high temperature and pressure.

Ans. I can not testify that I have seen any publication earlier than January 9, 1854, in which it is explicitly mentioned that *fat acids and glycerine* can be produced in the manner referred to.

PROFESSOR WAYNE, RECORD p. 860.

Q. 135. Can you swear that you have ever seen any publication or date earlier than January 9, 1854, in which it is explicitly mentioned that fats can be decomposed into free fat acids and glycerine, by the action of water at a high temperature and pressure? Please answer directly, yes or no.

Ans. I have not seen such publication.

APPELLEE'S WITNESS GRANT, A MANUFACTURER OF FAT ACIDS, RECORD, p. 925.

Q. 35. When did you first learn that fats could be decomposed into fat acids and glycerine by the action of water at a high temperature and pressure?

Ans. Shortly after Mr. Richard A. Tilghman took out his patent —I can't fix the date—and from that patent.

Q. 36. Can you name any book, published prior to 1854, in which is distinctly stated that fats can be decomposed into fat acids and glycerine by the action of water at a high temperature and pressure?

Ans. No, I cannot.

APPELLANT'S WITNESSES.

PROFESSOR BOOTH, RECORD 609.

Q. 135. Does any one of defendants' exhibits, Nos. 1 to 19, contain a description of a process substantially resembling complainant's process in principle and operation? Does any of said exhibits contain the announcement of the chemical fact upon which complainant's process is based?

Ans. Not one of the defendant's exhibits, from 1 to 19, describes a process substantially resembling the plaintiff's in principle or operation. Not one of said exhibits announces the cardinal fact of plaintiff's process, that fats are decomposed into fat acids and glycerine by the action of water at a high temperature and pressure.

SAME WITNESS. RECORD, pp. 587–8.

Q. 33. From your knowledge of chemistry, who would you say was the discoverer of the chemical power of water in a liquid state, at a high temperature and pressure on fats, to produce fat acids and glycerine?

(Objected to as calling for incompetent testimony.)

Ans. Mr. Richard A Tilghman.

Q. 34. Do you know of any other person who has claimed the merit of this discovery?

(Objected to as calling for incompetent testimony.)

Ans. I know of no other.

Q. 35. Is this discovery regarded as a new and important fact in chemistry?

(Objected to as being leading and incompetent.)

Ans. It is so regarded.

PROFESSOR ROGERS. RECORD, p. 632.

Q. 65. Do any of the Defendant's exhibits, Nos. 1 to 21, contain a description of a process substantially resembling the process patented to Complainant in principle and operation, or an announcement of the fundamental chemical fact upon which Complainant's process is based, to wit: the decomposition of fat into fat acids and glycerine by the action of water at a high temperature and pressure?

Ans. I have studied very carefully and critically, with reference to the meaning of the language employed, the documents and treatises containing the matter brought forward in said exhibits, and I have been unable to recognize in any one of the descriptions a process substantially resembling the process patented to Complainant; nor can I see in them any announcement of the fundamental chemical fact upon which the Complainant's process is based —the decomposition of fats into fat acids and glycerine by the action of water at a high temperature and pressure.

PROF. F. A. GENTH, RECORD, p. 86–87.

Q. 4. Have you read, and do you understand the Defendant's Exhibits, from 1 to 15, and from 18 to 20 inclusive? and if so, state whether or not you find described in any of them the process set forth and claimed in the Plaintiff's patent. (Same objection.)

Ans. I have read and do understand the Defendant's Exhibits referred to, and find that in neither one of them any mention is made of a process to decompose neutral fatty substances by highly heated water under pressure, but that they speak of various matters not in the least connected with this question.

PROF. ROBERT BRIDGES, RECORD, p. 72.

Q. 4. Have you read, and do you understand the Defendant's Exhibits, numbered from 1 to 15 inclusive, and from 18 to 20 inclusive? and if so, state whether or not you find described in them or any of them the process set forth and claimed in Plaintiff's patent? (Objected to by Defendant. Same objection as heretofore).

Ans. I have read the above-mentioned Exhibits, and do not find in them or any of them, any account of a process of decomposing fats by means of water at a high temperature and under high pressure, and do not find therein given the process of complaint as exhibited in his Letters Patent.

Prof. Wolcott Gibbs goes over Appellee's Exhibits one by one, and thus concludes. Record, p. 31.

Q. 50. State when and by whom your attention was first called to the question of the *novelty* of the Plaintiff's patented invention *as affected by defendant's Exhibits?* State whether you then made a full investigation of the subject, and report and state the substance of any such report.

Ans. (Objected to.) My attention thereto was first called by Mr. Mitchell, the Defendant, in the early part of the year 1863. I then made a full investigation of the subject at his request, and gave him a written opinion, the substance of which was *that the Plaintiff's invention was new.*

The entire novelty of the Plaintiff's discovery that water at high temperature and pressure would alone decompose fats, is strikingly shown by the fact that Prof. J. C. Booth, when informed by the Plaintiff in 1853 of the *results* only of his process, was unable to suggest the means by which they could be obtained. When it is remembered that Prof. Booth had regularly lectured on this manufacture during ten years in which he was Professor of Chemistry applied to the arts, at the Franklin Institute, Philadelphia, and had in 1852 made a full "Report on the Progress of Chemical Manufactures," at the request of the Smithsonian Institute of Washington (Record 87, p. 26), it will be admitted that no one would be more likely to be fully informed of all that was really known on the subject to chemists at that time.

J. C. BOOTH, RECORD, p. 56.

Q. 48. Did Mr. Tilghman, Complainant, mention to you the results obtained by him in decomposing fat, and if so, when first, and state whether or not you were able with your knowledge then, to state how the thing was accomplished? (Declaration of Complainant objected to by defendant's counsel.)

Ans. Mr. Tilghman, mentioned to me some time in the fall of 1853, that he could decompose fats so as to get their products without the use of chemicals, and that he was just on the point of leaving for Europe to take out a patent for the process. I told him in reply that I could not conceive how the decomposition could be performed unless by electricity.

It is proved by Appellee's Exhibit 19, that although it had long been well known that the elements of water are always *taken up* or *absorbed* when fat is decomposed by the powerful alkalies or acids, yet, that it was entirely unknown to chemists in 1850, that *water* alone could decompose neutral fat into fat acid and glycerine.

APPELLEE'S EXHIBIT 19, RECORD p. 259, Q. 191.

"In conclusion the saponification* of stearine *on the supposition* that it *could* be effected (*en supposant qu'elle put s'effectuer*) by the simple action of water *should* be expressed by the following equation."

PROF. GIBBS, RECORD, p. 30.

Q. 44. (Objected to.) State whether the passage in this exhibit commencing: "In conclusion, the saponification," &c., is or is not in effect a positive acknowledgment, that the decomposition of stearine into stearic acid and glycerine by the simple action of water, was not known to be practicable?

Ans. I think it is.

PROF. J. C. BOOTH, RECORD, p. 52.

In "Exhibit 19," from the Chemistry of Pelouze and Fremy, 1850, vol. 3, pp. 570 and 571, there is a theory of the manner in which we should view the compounds of stearic acid, and in order to simplify the formula presented, the authors state that the saponification of stearic acid, on the supposition that it could be effected with the simple action of water, should be expressed by an equation in which stearine, supposed to consist of a hypothetical dry stearic acid and a hypothetical dry glycerine, would take up respectively 2 atoms and 1 atom of water to form hydrated stearic acid and glycerine. By their making the supposition "*if* the saponification *could* be effected by the simple action of water," *it is evident they did not know that such an operation could be performed.*

Q. 4. PROF. F. A. GENTH, RECORD, p. 87.

* * * And, in fact, Exhibit 19 distinctly states, that there had not existed at that time any knowledge of the decomposition of neutral fatty substances by water.

ACKOWLEDGEMENT OF TILGHMAN AS DISCOVERER OF WATER PROCESS MADE PRIOR TO OR OUTSIDE OF ALL LITIGATION.

1856.—LECTURE OF G. F. WILSON BEFORE THE SOCIETY OF ARTS, LONDON. IN FULL IN RECORD, p. 112.

"In January, 1854, Mr. Tilghman, an American chemist, who "has studied all that has been publlshed here and in France, on "the subject of acidification and distillation of fatty bodies, ob- "tained a patent for exposing fats and oils to the action of water "at a high temperature, and under great pressure, in order to "cause the combination of the water with the elements of the "neutral fats; so as to produce at the same time free fat acids and

"solution of glycerine. He proposed to effect this by pumping a "mixture of fat and water, by means of a force pump, through a "coil of pipe heated to about 612° Fahrenheit, kept under a pres- "sure of about 2,000 lbs. to the square inch; and he states that "the vessel must be closed, so that the requisite amount of pres- "sure may be applied to prevent the conversion of water into "steam. This is, all must admit, *a beautiful, original*, chemical "idea, *well carried out;* it has yet to be proved how far it can "compete successfully will distillation. We have made an ar- "rangement with Mr. Tilghman which will give us the means of "testing its commercial merits."

Mr. Wilson had, together with others, seen Tilghman's process in operation during the spring and summer of 1855. R. pp. 91 & 1014, and in the new testimony introduced in this suit are letters from other parties who had seen the process, bearing witness to its entire novelty and great utility. Professor Thomas Graham, the Professor of Chemistry of the London University, a man of world-wide reputation, who shortly afterwards became the successor of Newton and Herschell as Master of the Royal Mint, writes under the date of September 15, 1854.

EXHIBIT GRAHAM, RECORD p. 1018.

* * * "I am glad to learn that the arrangements for forming the new company to purchase and carry out your stearine patent are advancing so favorably. * * * * The return to be made to yourself on the part of the company, although considerable, appears to me no more than is just and reasonable, *considering the well-defined character, undisputed novelty, and valuable nature of your invention.*

"I think of applying when I get back to town * * * for a portion, say 10,000, of stock of the company.

"This, I understand, would involve an outlay of £2,000. I would, also, not object to take a hand in the direction, if it is thought right to have a professional chemist associated with your city magnates for that purpose. * * * * *"

Warren S. Hale, a large manufacturer of stearic candles, writes under the date January 1, 1855.

EXHIBIT HALE, RECORD p. 1035.

"My Dear Sir:—In answer to your inquiries as to my opinion of your patent process for treating fatty substances, I have great pleasure in answering that ever since I first saw it in operation, I

have been satisfied that it must produce an important change in the manufacturing of candles.

"I am fully convinced of its practicability, and that it effects a great saving over the other methods now in use, which I have no doubt it must in a short time entirely supersede. * * *

With respect to the novelty of your process, I can only say that during my long acquaintance with the trade and with various processes in use or suggested, I have not met with anything at all resembling it either in principle or the mode of operation."

Frederiek Meyer, another large manufacturer, writes in the same strain. His letter is dated December 29, 1854.

EXHIBIT MEYER, RECORD P. 1036.

"DEAR SIR:—I have much pleasure in conforming with the request in your letter of a few days since, and to state that *the favorable opinion I formed on first seeing your patent process* in respect to its bearing on all fats and oils used for the manufacture of candles, *is entirely unchanged and greatly strengthened by subsequent investigations.* There appears to me no doubt as to its practical applicability to the manufacture in question and its ensuring a considerable saving in the cost of chemical agents as compared with the processes now in use. The waste of the material operated upon will be necessarily diminished in no small degree. * * *As far as my knowledge of patented processes goes, I know of nothing resembling yours, either in the chemical action which takes place or in the practical mode of operation.* * * * *

"I shall at any time be happy to aid you in the furtherance of your object respecting *this process of which my original favorable opinion is unchanged.*"

1858. PLAINTIFF'S TESTIMONY, TILGHMAN *vs.* WERKS.

RECORD pp. 435–6.

U. S. PATENT OFFICE,

June 26, 1858.

SIR:—Your application for a patent for an improved treatment of fatty acids has been examined. You are referred to Regnault's Chemistry, vol. 2, p. 1594, on Payen's Chemie Industrielle, p. 771, and to the patents of R. A. Tilghman, January, 1855, and October, 1854.

MR. T. IS THE ACKNOWLEDGED DISCOVERER OF THIS PROCESS.

The application is refused for want of novelty.

Respectfully, yours, &c.

J. HOYT, *Commissioner.*

M. WERK, ESQ.,
(Care of Munn & Co.,)
New York.

The official reports of the juries of the International Exhibition held in London in 1851 and 1862, and in Paris in 1855, give additional light upon the question of novelty of Tilghman's process.

These juries are known to be composed of the most eminent scientific and practical men in their respective branches to be found in Europe.

The report of the London Exhibition of 1851 contains a detailed history of the rise and process of this manufacture, from its origin by Chevreul down to 1851, including all the distillation and other processes referred to in Defendant's exhibits.

Not one word can be found in that report alluding in any way to the process of decomposing fats by the action of water heated under pressure.

This was less than three years before Tilghman's patent.

The report of the Paris Exhibition of 1855 also gives the history of the various improvements in this manufacture, and states that Chevreul had discovered and announced all the chemical facts upon which they were based, "*with the exception of the decompo-*
"*sition of the fats by water, which remained unknown to him,*" and that Tilghman was the first to discover and propose this process.

The report of the London Exhibition of 1862 recognizes Tilghman as the inventor of the water process, awards him a medal therefor, and states that De Milly's process, with two and a half per cent. of lime, *is, in fact, but a combination of Tilghman's mode*
"*of saponification by water at a high temperature, combined with*
"*the lime process.*"

These independent, unsought, and, as it were, accidental expressions of opinion, coming from such varied and competent authorities, cannot fail to have due weight with the Court.

EXPOSITION UNIVERSELLE DE 1855.

(Held at Paris.)

JURY REPORT.

p. 486. "STEARIC CANDLES."

RECORD, p. 743.

"* * The stearic manufacture was originated in France. "It
"is founded upon the investigations of M. Chevreul as to the con-

"stitution of the fatty bodies. In a series of eight memoirs, "which will remain an imperishable monument of his sagacity, "this illustrious chemist has made known the true nature of the "neutral fatty bodies, the properties of the acids which we can "derive from them, and the conditions under which these acids are "formed. All the chemical investigations undertaken since have "only served to confirm the scrupulous accuracy of all these obser- "vations. *We can affirm, without fear of contradiction,* THAT "WITH THE EXCEPTION OF THE UNDERTAKING OF "THE SAPONIFICATION OF THE FATTY BODIES BY "WATER, WHICH REMAINED UNKNOWN TO HIM, *he "has indicated in a clear and precise manner all the scientific bases "upon which depend the different methods of practical manufacture "of the fat acids employed for making candles.*"

P. 496. AQUEOUS SAPONIFICATION IN A CLOSE VESSEL. SAME REPORT. RECORD p. 910.

"Chemists liken neutral fatty matters to the compound ethers. "This hypothesis was put forth for the first time by M. Chevreul, "in his "Researches on Fatty Bodies.

"As the 'ethers' undouble when they are heated to a high "temperature in close vessels with water, one was led quite natu- "rally to attempt to effect this undoubling with neutral fatty "bodies. Experience has confirmed this prevision. This is the "origin of the *new processes* of saponification which we are about "to set forth in a few words. *It was Mr. Richard Albert Tilghman, "chemist, of Philadelphia, who was the first who had the idea of ap- "plying this reaction on a large scale.* In his patent taken in Lon- "don, the 25th of March, 1854, he thus sets forth *his discovery,* "and his manner of operating.

"My invention consists in a new method of obtaining free fat "acids and solution of glycerine from animal and vegetable fatty "and oily bodies which have glycerine as their base. * *

"My invention consists in exposing the aforesaid fats, and oils "to the action of water at a high temperature and pressure, the "effect of which is to cause the combination of the water with the "elements of the neutral fats, so as to produce at the same time "free fat acids and solution of glycerine."

REPORTS OF JURIES. RECORD P. 743-4.

INTERNATIONAL EXHIBITION, 1862. LONDON, 1863. CLASS IV.

SECT. A.—OILS, FATS, WAX, AND THEIR PRODUCTS.

Jury.

"P. J. Van Kerchoff, Ph. D., Netherlands, Professor of Chemis- "try in the University of Groningen. W. A. Miller, F. R. S.,

"President of Section, London, Professor of Chemistry, King's "College, London, Anseloma Payen, Deputy Chairman, France, "Member of the Institute, Professor of the Conservatory of Arts and "Manufactures, and Professor to the Central School of Arts and "Manufactures. J. S. Stas, Belgium, Professor of Chemistry at the "Military School of Brussels, Member of the Department of Science "of the Royal Academy of Belgium. Dr. Stein, Professor, Dresden. "George Wilson, F. R. S., Joint Secretary, London, Manager of "Price's Patent Candle Works.

Associate.

"L. A. de Milly, France, Chemical manufacturer.

"Page 3. Considerations of this nature led M. de Milly, as early "as 1855, to endeavor to modify the process of saponification by "means of lime; instead of effecting this decomposition at a tem- "perature of 212°, and employing 14 per cent. of lime, he raised "the temperature by working under pressure, and employing only "4 per cent. of lime,

"At the present time M. de Milly has indeed reduced the pro- "portion of lime to 2½ per cent. This process has been imitated "in Austria. Undoubtedly it constitutes a real improvement upon "the ordinary method of saponification by lime; *but in spite of this "considerable improvement*, WHICH IS IN FACT BUT A COMBINATION OF "MR. TILGHMAN'S MODE OF SAPONIFICATION BY WATER AT A HIGH TEM- "PERATURE COMBINED WITH THE LIME PROCESS, we cannot believe "that these two methods of saponification, under any modification "at present attempted, can, in an economical point of view, success- "fully compete with the sulphuric saponification."

Record p. 744.—MEDALS, *United States*.—Page 7. TILGHMAN for fatty acids obtained by aqueous saponification.

RECORD, p. 279.—EXHIBIT P.

MUSPRATT'S CHEMISTRY, LONDON, VOL. II, p. 252, ARTICLE, GLYCERINE.

"*A much more economical method is that introduced by "Tilghman, in 1854.* By this process the fatty bodies are broken "up into acid and basic substances through the agency of heat, "pressure and steam, as described at p. 433, vol. I, and form "separate layers in the recipient into which the products flow "from the condenser. The glycerine, which is the heavier of the "two, forms the lower stratum, and the fatty acids of the upper; "the latter can readily be separated mechanically, and the former "left devoid of any impurity excepting water. By careful con-

"centration the aqueous matter can be expelled, and the product "obtained of a specific gravity of 1.24, and containing only four "per cent. of moisture; but by prolonging the operation, two per "cent. more of water may be removed, and the pure glycerine is "left of a density 1.260."

RECORD, p. 279.—EXHIBIT Q.

WATT'S DICTIONARY OF CHEMISTRY, LONDON, 1864, VOL. II, p. 886, ARTICLE, GLYCERINE.

"3. By heating neutral fats with water or with steam. This is "the only unobjectionable method of obtaining glycerine, inas- "much as it alone insures the entire absence of mineral impurities. "*It was first carried out by Mr. Tilghman* in the following man- "ner: the fat or oil having been thoroughly mixed to an emulsion "with about half its bulk of warm water, is forced by a pump "through a long coil of strong iron tubing heated to about the "temperature of melted lead, the pump being worked at such a "rate that the liquid may occupy about ten minutes in traveling "through the coil. On issuing from the coil the liquid separates "into two layers, the upper of which consists of the fatty acids, "and the lower of an aqueous solution of glycerine, which re- "quires only to be concentrated by evaporation. This process is "very simple, and is capable of yielding very pure products."

Doctor Watt, it appears Record p. 1015, witnessed the successful operation of this process in the coil apparatus in London, May 12, 1855.

PRACTICAL CHARACTER OF TILGHMAN'S PROCESS IN BOTH FORMS OF APPARATUS.

Tilghman did practically apply this discovery, and he was the *first* practically to apply it in the arts.

He described in his patent two modes of applying it; the first was an ordinary digester, such as was then well known.

RECORD, p. 8.

I mix the fatty body to be operated upon with from a third to a half of its bulk of water, and the mixture may be placed in *any convenient vessel* in which it can be heated to the melting point of lead, until the operation is complete. The vessel must be *closed* and of *great strength*, so that the requisite amount of pressure may be applied to prevent the conversion of the water into steam.

This form of apparatus, the simple digester, was proved to work the Plaintiff's process successfully at all temperatures, from lead melting heat, or 612°, down to 320° F.

PROF. BOOTH, RECORD, p 588.

Q. 36. Have you made any experiments on the action of water at high temperatures and pressures upon fats? If you state when and where, describe the experiments in detail, and describe the results produced. If you deposited samples of the products of those experiments with any person, state when and with whom.

Ans. I made two experiments on the action of heated water on fat, in my laboratory, in August, 1860. In the first experiment lard was heated with twice its weight of water to 320° Fah. during eleven hours. All the water was drawn off and a small amount of fatty matter. The water contained glycerine, a sample of which was produced on the 4th of September, 1860, in the case of Tilghman *vs.* Werk, was deposited with the Commissioner, and marked No. 1, A. (C. F. H.) The quantity of glycerine proved that more than four-fifths of the lard had been resolved into fat acid and glycerine; a sample of the fatty product thus obtained was produced and deposited like the above sample, marked No. 1 A. (C. F. H.) Its highly acid character was proved by its hardness, as compared with the lard, by its crystallization, by its decomposing carbonated alkali with effervescence, by its great solubility in alcohol, and that this alcoholic solution reddened blue litmus. A sample of the lard used in this and the following described experiments was presented and deposited as above, and marked 1 C. (C. F. H.) The fatty product was again treated with twice its weight of fresh water, to 320° Fahr., for thirteen hours more, making twenty-four hours the whole time of its being heated to 320° Fahr. At the conclusion of this last time, the lard had been wholly resolved into fat acid and glycerine; the fat acid thus obtained was presented and deposited as above, marked 1 B. (C. F. H.) In the second experiment the lard was heated with twice its weight of water, but kept apart from each other, up to 612° Fahr, and when this temperature of 612° had been attained, they were mixed by agitation and kept heated at 612° during five minutes. The lard was wholly resolved into fat acid and glycerine, samples of which were produced and deposited as above, marked No. 3 fat acids, No. 3 glycerine, (C. F. H.)

SAME WITNESS, RECORD, P. 613.

Q. 149. Have you made any experiments to carry into literal execution the first described method mentioned in Tilghman's patent? If so, state the details when said experiments were made, and with whom you deposited samples of the product.

A. I made such an experiment on the 23d of March, 1864, in Philadelphia, by enclosing several ounces of pressed lard, with half as much water, in an iron tube lined with copper, tightly closing the same, and subjecting the mixture to the temperature of melting lead for forty minutes, without disturbing the vessel during that time, then cooling it rapidly with cold water, and pouring out the contents. I produced Exhibit R 1, as a sample of the glycerine water, as poured out from the tube and through filtering paper *after rendering* the mixed fat acids and glycerine water, and deposited it with the Commissioner in said suit against Mitchell. The glycerine water was subjected to no other process. I deposited Exhibit R 2, in the same suit, as a specimen of the fat acids rendered in this operation, and which had received no other treatment. I deposited in the same suit Exhibit R 3, as another portion of the rendered fat acid of this operation, settled, or clarified, by dilute sulphuric acid, and which has received no other treatment.

Tilghman's patent describes a special apparatus, which he considers the best form for applying his process continuously, but expressly disclaims limiting himself to it.

TILGHMAN'S PATENT, RECORD, p. 8.

In the drawing hereunto annexed are shown figures of an apparatus for performing this process speedily and continuously, *but which apparatus I do not intend to claim as any part of my invention.*

This special apparatus is shown by the declaration of George F. Wilson to have been successfully worked by Tilghman before him in 1854.

WILSON'S LECTURE DELIVERED BEFORE SOCIETY OF ARTS, RECORD, p. 113.

He proposed to effect this by pumping a mixture of fat and water, by means of a force pump, through a coil of pipe heated to about 612° Fahrenheit, kept under a pressure of about 2,000 pounds to the square inch; and he states that the vessel must be closed, so that the requisite amount of pressure may be applied to prevent the conversion of water into steam.

I went with my chemist assistant, Mr. Payne, to see Mr. Tilghman's little apparatus *at work*, and in the course of some experiments which *it* led us to try, or rather to try over again, it struck me that steam passed into the fat at a high temperature should ef-

fect, by a gentle process, what Mr, Tilghman aimed at effecting by a violent process—the resolving of the neutral fat into glycerine and fat acids. In July, 1854, we took out a patent for this process.

During this year, also, the same apparatus was exhibited in successful operation to many chemists and manufacturers, as is testified to by Tilghman.

RECORD, p. 1014.

"*Q.* 13. You have stated (R. 87, p. 75) that you exhibited your "process in operation in the coil form apparatus to G. F. Wilson, "manager of Price's Patent Candle Company, London. State "whether it was also exhibited to any other manufacturers or "scientific men.

"*Ans.* On May 6th, 1854, it was shown, in operation, to Mr. "*Frederick Meyer*, the head of the firm of Chas. Ogleby & Co., and "one of the patentees, Radley and Meyer (exh. 10, Werk's case, p. "189). Their works, manufacturing by the old lime-saponification "process, is described in the report of juries of London Exhibition "of 1852, p. 621, and was probably larger than any other in the world "on that plan, saponifying ten tons of fat at each charge. His let- "ter on the subject of my process is hereto annexed, marked Ex- "hibit Meyer.

"My process was also shown to *Warren S. Hale*, May 26, 1854. "This gentleman is also mentioned in the same report of the Exhibi- "tion of 1852, page 621, as one of the largest makers of stearic "candles in England. He was at that time an alderman, and the "next year was Lord Mayor of London. I offer, as an exhibit, "Hale, his letter to me on the subject of my process.

"*F. Z. Bauwens*, manager of Bauwens Candle Co., saw my pro- "cess, May 19, 1854, and *Mr. Butt*, the secretary of the British "Sperm Candle Co., saw it on June 1, 1854.

"*Prof. Graham*, then Professor of Chemistry of London Uni- "versity, and soon afterwards Master of the Royal Mint, having "made an appointment to see the process on May 12th, 1854, "brought with him *Dr. Hoffman*, Professor of the Royal College of "Chemistry, *Dr. Miller*, Professor of Chemistry of King's College, "London, *Prof. Williamson*, Professor of Organic Chemistry in Lon- "don University, *Dr. Henry Watts*, the author of Watts' Chemical "Dictionary, *Prof. Anderson*, of Glasgow University, and several "other chemists whom I did not know. *The coil apparatus was "worked in their presence*, and samples of all the materials and pro- "ducts were taken by many of them. Several experiments were "made on the spot by Prof. Williamson, to test the purity of the "products, and he soon after gave a lecture at the Chemical So- "ciety on the chemical powers of water, especially as exhibited in "my process."

In confirmation of this testimony, we have letters from Graham, Master of the Royal Mint and one of the most distinguished of modern chemists, and from Hale and Meyer, practical manufacturers.

EXHIBIT GRAHAM, RECORD, p. 1018.

Glascow, September 15, 1854.

"* * * The return to be made to yourself on the part of "the company, although considerable, appears to me to be no more "than just and reasonable, *considering the well defined character, "undisputed novelty and valuable nature of your invention.* * *"

EXHIBIT HALE, RECORD, p. 1035.

34 Orange Street, January 1, 1855.

"MY DEAR SIR:—In answer to your enquiries as to my opinion "of your patent process for treating fatty substances, I have great "pleasure in answering that ever since *I first saw it in operation* "I have been satisfied that it must produce an important change in "the manufacture of candles.

"*I am fully convinced of its practicability*, and that it effects a "great saving over the other methods now in use, which I have "no doubt it must, in a short time, entirely supersede. * * * "*With respect to the novelty of your process, I can only say that during "my long acquaintance with the trade, and with various processes in "use or suggested, I have not met with anything at all resembling "it, either in principle or in the mode of operation.*

"I remain, my dear sir, yours truly,

"WARREN S. HALE.

"To R. A. TILGHMAN, ESQ., etc., etc."

EXHIBIT MEYER, RECORD, p. 1036.

53 Paradise Street, Lambeth, 29 December, 1854.

"DEAR SIR:—I have much pleasure in conforming with the re- "quest in your letter of a few days since, and to state that *the fa- "vorable opinion I formed on first seeing your patented process in "respect to its bearing on all fats and oils used for the manufacture "of candles, is entirely unchanged and greatly strengthened by sub- "sequent investigations.*

"*There appears to me no doubt as to its practical applicability to "the manufacture in question, and its ensuring a considerable saving "in the cost of chemical agents, as compared with the process now in "use.* The waste of the material operated upon will necessarily diminish in no small degree. * * * * * *

"*As far as my knowledge of patented processes goes, I know of* "*nothing resembling yours, either in the chemical action which takes* "*place or in the practical mode of operation.* * * *

"I shall at any time be happy to aid you in the furtherance "of your object, respecting this process, of which *my original fa-* "*vorable opinion is unchanged.*

"I am, dear sir, yours, very truly,

(Signed,) FRED. MEYER.

"MR. R. A. TILGHMAN."

The testimony of Tilghman (R. p. 91,) shows that Price's Patent Candle Company, of which G. F. Wilson is Managing Director, took a license at £1,000 a year, and although they have the option of abrogating this license, they never did so.

The following witnesses, who tried the coil apparatus of Tilghman, produced specimens in Court, and testified as to its practical character.

Professor J. C. Booth, the chemist of the United States Mint, and author of the Encyclopædia of Chemistry, states:

RECORD, p. 610–11.

"I tried the second apparatus, indicated in the patent, with an "apparatus quite similar to the drawing accompanying the specifi- "cation to Mr. Tilghman's patent, except that the coil was circular, "rising in a continuous spiral coil from below upwards, so that the "exit pipe came from the upper part instead of the lower, as indi- "cated in said drawing. There was a force pump drawing an "emulsion of melted fat and water from a vessel in which it was "heated and agitated, and forcing it into the coiled tube, which "was heated by a fire to about the melting point of lead. The "exit pipe outside the heating apparatus formed another shorter "coil, which was cooled by water to below 212° Fahr.; and termi- "nated in a final exit pipe, which was controlled by a weighted "valve. The pipe of the whole coil had a full inch exterior, and "a full half inch interior, diameter. The temperature was deter- "mined by three tubes closed at their lower ends, abutting against "the outside of the heated coil, and containing, respectively, bis- "muth, lead, and saltpetre. The temperature was shown during "the working by the saltpetre being never melted, the bismuth "melted all the time, and the lead melted nearly the whole time, "except during a few minutes of solidification. The weight on the "exit valve was arranged to counter-balance the pressure in the "coil, so that material would only flow out when the force pump "was worked. We measured nearly two gallons of pressed lard,

"and one gallon of water, which passed through the apparatus in "less than an hour. I produced a specimen of the pressed lard "used, deposited it with the Commissioner, as Exhibit V 1, in the "suit of Richard A. Tilghman *vs.* Roland G. Mitchell, in equity, in "the Circuit Court of the United States for the Southern District "of New York. I also produced a specimen of the product passed "through the apparatus, which I deposited with the Commissioner "marked V 2.

"The fatty product from the apparatus ran out of the consistence "of soft butter nearly the whole time. When it ran thinner a sam- "ple was taken, produced, and deposited, as Exhibit V 3, with "same Commissioner, in same suit; it solidified on cooling. The "aqueous liquid which separated on *rendering* a basin full of the "product, that is, by keeping it melted for a short time, was evapo- "rated and yielded glycerine, which was deposited as Exhibit V 4 in "same suit.

"The fatty matter which came through the apparatus was tested "by hot alcohol, and found to dissolve entirely, and on cooling the "solution very little unaltered fat separated from it. I estimated "not one per cent. The pressed lard tried in the same way was "wholly insoluble in alcohol. As pressed lard was used, and the "product consisted of glycerine and crystalized fat acid, and matter "from which mere traces of unaltered fat were obtained, the decom- "position was practically complete. I performed this experiment "March 9, 1864."

Q. 140. From the character of the results which you obtained, what is your opinion as to the practical utility of the process of Mr. Tilghman?

Ans. As we obtained at the rate of four hundred to four hundred and fifty pounds in twenty-four hours, in so small an apparatus, and as the product consisted of fat acid and glycerine, I regard the process as a most perfect manufacturing process—that is, making fat acid and glycerine in an economical manner, and adapted to commercial uses.

Dr. Robert E. Rogers, Professor of Chemistry in the University of Pennsylvania, also testifies to the perfectly successful working of Tilghman's coil apparatus.

RECORD, p. 673.

Q. 32. Were you present at any trial of the process of Complainant in the coil apparatus described in his patent? If so, state who was present, and whether or not in your opinion said apparatus is a practical one for carrying on said process of Complainant.

Ans. I was present at a trial of the process referred to in the question, in company with Professor James C. Booth, Dr. Robert Bridges, and Mr. R. A. Tilghman. It is my opinion, and not only my opinion, but my thorough conviction, that it is a process altogether adapted to carrying out the method of Mr. Tilghman.

Q. 33. Was the value of the fat acid and solution of glycerine produced thereby impaired by the presence of acroleine, and if so, to what an extent?

Ans. The odor of the products evinced nothing offensive which would indicate the presence of acroleine as a hurtful substance, the small amount of oxide of iron being an accidental, and not necessarily present substance, and was readily removable.

Professor Booth also proved the *quality* of the fat acid and glycerine produced by Tilghman's coil apparatus, by submitting them to the regular processes used in candle works.

RECORD, p. 614.

Q. 152. Have you made any experiments on the practical mode of purifying and pressing the fat acids produced in your trial of Tilghman's coil apparatus? If so, describe such experiments, and state with whom you deposited samples of the products.

Ans. I rendered a quantity of the fat acids obtained by me with the coil apparatus, by boiling by means of steam with diluted sulphuric acid and allowing the fat acids floating on the aqueous liquid to cool to a solid mass. I deposited exhibit Q 1 as a sample of such cooled solid mass, in said Mitchell suit, with the Commissioner. A portion of the solid mass was subjected to cold pressure, and then to warm pressure, between copper plates, to remove the fluid fatty matters, and the remainder, consisting of solid fat acids, was cast into a glass tube and deposited with the Commissioner in the same suit as Exhibit Q 2. Another portion of such solid fat acids was cast into a porcelain crucible and deposited with the Commissioner in said suit as Exhibit Q 3.

Q. 153. Can you state of your own knowledge whether the working of Tilghman's coil apparatus produces fat acids fit for making candles, and glycerine fit to be sold as a commercial product, after purification by the ordinary methods?

Ans. By comparing the solid fat acids obtained by the coil apparatus, and subsequent clarification and pressure, with the solid fat acids obtained in Grant's candle factory, in Philadelphia, by the sulphuric saponification, I believe that the product of the coil apparatus is fit for making candles. By comparing the glycerine which I obtained by the coil apparatus with several kinds of glycerine of commerce, I believe that the coil apparatus will make a

glycerine suitable for commercial purposes, equal to that produced by any other process, after resorting to the usual method of purification.

The Appellee's witnesses cannot deny that with the coil apparatus of Tilghman, even as tried by themselves, both fat acid and glycerine were always obtained, they are therefore limited to objecting to the bad *smell* of the products, a result due entirely to their own mismanagement of the process, and not produced as proved above, when the directions of the patent are complied with.

MITCHELL'S PARTNER, F. VERDIN, RECORD, p. 777.

Q. 5. Have you made any experiments to ascertain whether the improvement described and claimed in said Letters Patent can be practically worked? If so, state fully what experiments you have made, when and where they were made, how they were made, and what was the result of the same.

Ans. I have tried—first, in a small vessel, six inches deep, half inch bore, with a valve at the end of it, kept down with a screw at the top, so that it would resist the pressure required. I filled the vessel one-third with water and two-thirds with fat, and immersed it in a potful of melted lead, and kept it immersed for ten minutes; afterwards I cooled it down rapidly, and by the opening I *found fatty acids* with *glycerine* and acroleine. I have made several more experiments in the same manner, and the results were the same. I made these experiments at R. G. Mitchell & Co's factory, about four years ago; I think in 1864.

This witness admits that these products had less color and smell than those of the sulphuric acidification process, and could be purified in the same well-know way.

F. VERDIN, RECORD, p. 785.

x*Q.* 69. Was the fat acid produced in your experiments with the coil apparatus darker or lighter in color than fat acids acidified by sulphuric acid?

Ans. It was a great deal lighter.

x*Q.* 70. In your opinion, could not the fat acids produced in your said experiments have been purified by distillation, in the same way as the darker fat acid acidified by sulphuric acid?

Ans. They could be purified by distillation, but it adds to the expense; for instead of one process you have two.

x*Q.* 71. Would not distillation remove the smell as well as the color?

Ans. I do not think it would entirely, as there is always with the distilled fatty acids a peculiar kind of smell, and that, I presume, results from the acroleine.

Q. 72. You mean that it would probably have the same smell as the distilled products of the sulphuric acid process, do you not?

Ans. The same as I smelled it in the Ohio candle works.

Q. 73. The distilled products in the sulphuric acid process are largely manufactured and sold in commerce, are they not?

Ans. They are.

This witness admits that in his trials if the coil apparatus, the directions of the patent that the tubes should be kept full of the mixture and free from steam, were not complied with.

VERDIN, RECORD, p. 784.

Q. 55. In these explosions a large quantity of the mixture was thrown out at one time, was it not?

Ans. It was.

Q. 56. And the tubes were then partly empty of the mixture, and consequently so far filled with steam, were there not?

Ans. I suppose they were.

He also admits that he allowed only ten minutes for the mixture to go through the coil, whereas the patent directs that the mixture should be kept in the coil for ten minutes *after it had attained the temperature of melting lead.*

RECORD, p. 875.

Q. 61. In your experiments, the rate of working of the pump was the same at all the temperatures used, from melting tin to melting lead, was it?

Ans. It was always the same—so that it should take ten minutes to go through the coil. My aim was to complete the operation in ten minutes, as prescribed by the patent.

MANNER IN WHICH APPELLEES TRIED TILGHMAN'S COIL.

F. Verdin, Mitchell's partner, had charge of all coil experiments, and he thus testifies.

RECORD, p. 785.

"x*Q.* 62. Had you the chief direction and management of all the experiments with the coil apparatus made in New York and Cincinnati?

"*Ans.* I had here in New York, to a certain extent, and my nephew, who is now deceased, to the other extent; and in Cincin-

nati I did not want to have anything to do with it whatever. I wanted the manufacturers of Cincinnati to operate with it themselves, so that they could judge for themselves the value of the process. I also, at their request, *took the chief management of it in Cincinnati.*

RECORD, p. 784.

"x*Q.* 52. Was the rate of discharge from the exit-valve more regular when the coil was at the heat of melting tin or bismuth, than when it was at the heat of melting lead?

"*Ans.* It was more regular at the melting point of tin.

"x*Q.* 53. The explosive discharges you have spoken of occurred at the melting point of lead, did they not?

"*Ans.* They occurred between the melting point of bismuth and lead.

"x*Q.* 54. What was the reason of this difference do you suppose?

"*Ans.* I suppose by putting a *much heavier weight on the lever* of the valve it might prevent these explosions.

"x*Q.* 55. In these explosions a large quantity of the mixture was thrown out at one time, was it not?

"*Ans.* It was.

"x*Q.* 56. And the tubes were then partly empty of the mixture, and consequently so far filled with steam, were they not?

"*Ans.* I suppose they were.

"x*Q.* 57. In your experiments, was the same weight used on the exit-valve at all the temperatures, from melting tin to melting lead?

"*Ans.* The same weight was used at all the melting points."

RECORD, p. 785.

Perfectly understanding that the patent called for longer time at tin than at lead melting heat, he persistently refuses to so try it.

"x*Q.* 60. Did you not understand from the patent that at the temperature of melting tin a longer time would be required to produce decomposition than at the melting point of lead?

"*Ans. I did understand that.* The time is not mentioned in the patent. It only speaks of ten minutes.

"x*Q.* 61. In your experiments the rate of working of the pump was the same at all the temperatures used, from melting tin to melting lead, was it?

"*Ans.* It was always the same—so that it should take ten minutes to go through the coil. My aim was to complete the operation in ten minutes, as prescribed by the patent. (Rec. p. 786.)

"x*Q.* 74. In your opinion, is not the proper regulation of the exit-valve the most important feature of the working of the coil apparatus?

"*Q. I suppose it is, if it can be done;* and I wish that some one would show me how to do it." (Rec. p. 785.)

The drawing of the Patent shows him how to do it, by using a spring balance. He follows the drawing with minute accuracy in all the *unimportant* features, but the one he knows to be *vital* he alters. The spring closes the valve instantly after lifting, while the weight falls very slowly, as he himself remarks—

"The irregular action is caused by the great pressure on the valve when the valve opens once. It does *not shut fast enough*, and that caused the discharge to be greater than the supply, and leaves steam room in the pipe." (R. p. 778.)

And yet this partner of Mitchell, Florence Verdin, with the full knowledge not only of his bad result, but also *why* it was bad, and that the patent showed a spring, goes on using a weight which he finds too light, but never changes, and says he left it to the mechanic to calculate, and the mechanic left it to him; and so nobody did it. (F. Verdin's Testimony, R. p. 784.)

"x*Q.* 58. Have you any direct personal knowledge of the amount of pressure produced in the tube by the weight used on the lever of the exit-valve?

"*Ans.* I had not. I left that to the mechanic who built the machine."

"William Thomas, sworn on part of Defendant, says (R. 204):

"*Q.* 1. What is your name, age, residence, and occupation?

"*Ans.* William Thomas; age, thirty-eight years; residence, New York City; am a machinist and engineer.

"*Q.* 2. Have you recently put up a coil apparatus for operating on fats? If so, state when and where, and describe the apparatus.

Ans. I have, in Mr. Van Horn's shop, in Fifth street, between Avenue D and Lewis street, last week or the week before. It was a coil," etc. (R. 209.)

"x*Q.* 76. Who loaded the safety-valve?

Ans. I cannot say.

"x*Q.* 77. Would the steam, generated at the melting point of lead, have sufficient pressure to open that safety-valve as it was loaded?

Ans. I don't consider it would be steam any more at the melting point of lead. I think it would be a gas.

"x*Q.* 78. Would the thing, whether it be gas or steam, generated at the melting point of lead, have sufficient pressure to open the exit-valve in the apparatus which you tried?

"*Ans. I didn't load the valve*, and therefore I cannot answer that question." (R. 209).

"x*Q.* 38. Who superintended the apparatus which you made, and which you saw tried yesterday at Mr. Mitchell's factory.

Ans. I can't say that there was any particular one; all seemed to take a hand in it that were there.

"x*Q.* 39. Who all were there?

"*Ans.* There was myself, Mr. Verdin, Sr., and Mr. Verdin, Jr., and two germans—one of the engineers in Mr. Mitchell's factory, and the other attends the fires; also Mr. Thain, Mr. Goddard, Mr. Mitchell. I don't know that Mr. Mitchell stopped through the whole. And there was one more gentleman.

"x*Q.* 40. What did you do?

"*Ans.* I was sometimes a taster and smeller; I also worked the force-pump sometimes, and went round the whole of it,

"x*Q.* 41. Can't you tell me who conducted the experiment?

"*Ans.* I really cannot. I have told you before it was a general thing. (R. 207.)

THE APPELLANT OFFERED TO SHOW COIL-APPARATUS PRACTICALLY AT WORK, TO MITCHELL, AND IT WAS DECLINED.

Just before the testimony had been closed in this case Mitchell asked for the inspection of Appellant's apparatus; it was declined on that account, but as soon as the court fixed a later day for hearing the case, the apparatus was tendered and refused.

RECORD, p. 80–81.

"The Defendant requests the opportunity of performing an experiment, or experiments, on the coil-apparatus used by the Complainant in his experiments which have been testified to, at which the Defendant may be present, to which he will attend as early as next week, after Monday, as may suit Complainant's convenience, in Philadelphia.

March 24, 1864.

"Present, counsel for respective parties.

"In reply to the request made at the adjournment on the last day of taking testimony by the Defendant for the use of the coil-apparatus to experiment with, Mr. Tilghman replies:

"That the coil-apparatus is very weighty and bulky, and was dismantled at the request of Professors Booth and Bridges, the day after the experiments therewith were tried by them, in order to enable them to examine its interior construction and dimensions; that to get the coil-apparatus again in working order, and try new experiments, would require considerable time and delay the hearing; that the Defendant neglected to make his request until the moment of adjournment on the day originally fixed for closing the testimony; that the Complainant has, however, caused the same experiments to be repeated in a more portable apparatus, which he produces and marks Exhibit 'Digester,' and now formally offers to experiment with it, and try any pertinent experiment in the presence of Defendant, on Friday, March 25th, at any suitable place and hour which Defendant will now indicate it being understood also that such experiments tried for Defendant are not to be permitted to delay the hearing.

To this offer of Appellant, no reply whatever was made.

May 6th, 1864.

Council for Defendant offers to repeat the experiments in the coil-apparatus and on the Scharling apparatus, in the presence of Complainant, and make alterations therein to make it conform to Complainant's patent, if any are necessary; it being understood that such experiments are to be made at a time which will give opportunity to give evidence in this cause in respect thereto. Also to repeat the experiments on the Scharling apparatus in Complainants's presence.

"Mr. Harding replies, by giving in evidence the following offers, which is marked 'Exhibit, April 13, 1864,' together with the affidavit of service thereof on Defendant's counsel, together with his reply, April 15, 1864; and further refers to his offer to repeat the Complainant's experiments on the digester contained in the record on the date of March 24, 1864. And further adds that, as the Complainant has a complete apparatus, constructed in accordance with his patent, the successful operation of *which he has proved by disinterested experts*, and has repeated the offer to exhibit to the Defendants, he cannot see any reason why he should occupy time in altering the apparatus now at the Defendant's works, especially since the time for closing testimony and the day of hearing will not leave time to re-open this matter. (R. p. 90.)

APPELLANT'S EXHIBIT, APRIL 13, 1864. RECORD, pp. 113–114.

"*Philadelphia, April 13, 1864.*

"SIR:—On the 5th inst., I mailed to you the notice of which the following is a copy, requesting the favor of an answer within five days.

"For fear that you did not receive it, I now send this copy of my former note, requesting the favor of an answer accepting or declining my proposition within the five days after your receipt of this present notice, inasmuch as I have other engagements to which I wish to attend. I would also thank you to acknowledge the receipt of my former notice, if it was received by you.

"Very respectfully, yours,

"R. A. TILGHMAN.

G. C. GODDARD, Esq., (*Sol. for Defts.*)
"*17 William Street, N. Y.*"

"APRIL 5, 1864.

"SIR: The only objection which Complainant had to the repeating of his experiment on the coil-apparatus was the risk of delaying the hearing to the next term.

"As the court has ordered that the case shall still be heard this term, though at a later day, the complainant now offers to repeat the experiment tried by Professors Booth, Rogers, and Bridges, in the presence of the Defendant; and requests the Defendant to signify his acquiescence or refusal of this proposition within five days. If accepted, the Complainant will at once have his apparatus put in order, and then appoint the earliest day which may be convenient to both parties for the Defendant to visit Complainant's laboratory in Philadelphia and see the process in action.

"Very Truly Yours,

"R. A. TILGAMAN.

"G. C. GODDARD, Esq., (*Sol. for Defts.*)
"*17 William Street, N. Y.*"

"NEW YORK, *April* 15, 1864.

"DEAR SIR: Yours of the 13th is received, as was yours of the 4th or 5th, to which I think I made answer.

"After the use of your coil-apparatus by us was declined by you, we made arrangements which we hope will supersede the necessity of making experiments on yours. Should we change our minds, and desire to experiment on yours, we will advise you; *but at present we do not.*

"GEORGE C. GODDARD.

"MR. R. A. TILGHMAN."

Appellee's French witness, Moinier, is the only one who testifies that the coil apparatus will *not* decompose fats into fat acids and glycerine.

MOINIER, RECORD, pp. 504-8.

6th Int. * * The decomposition of the fatty matter was

never complete, and never produced fat acids and glycerine. * *

10th Int. * * The process never produced fat acids and glycerine.

14th Int. New experiments were made at La Villette, by Mr. Tilghman the younger, during the two or three months, and, like the first, produced neither fat acids nor glycerine.

16th Int. * * They produced neither fat acids nor glycerine.

14th X Int. * * First of all, it was necessary to obtain fat acids and glycerine, and we never obtained any.

Moinier further testifies that the supposed decomposition of fat by water at a high temperature and pressure *is an entire mistake*, and has no existence in fact.

RECORD p. 307.

5th xInt. In my opinion, a mixture of fatty bodies and water, exposed in a closed vessel at a high temperature, and under a strong pressure, *cannot decompose* the fatty bodies to the point of producing fat acids and glycerine.

12th xInt. I have never thought, and I do not yet believe, that either Mr. Tilghman, the patentee, nor his brother, wished to deceive us; but I believe that they *were mistaken*, and that they are *still mistaken* about the fundamental question, namely, that a mixture of fatty matter and water is decomposed into fat acids and glycerine, when exposed to a high temperature and strong pressure in said tubular apparatus.

11th Int. p. 305. I have also said, and I now affirm, that *it is impossible* to decompose fatty matter and obtain fat acids and glycerine by the method indicated in Mr. Tilghman's patent.

Moinier is directly contradicted by Appellee's witnesses, Mitchell and Verdin, who testify that they always obtain fat acids and glycerine, and some acroleine, in the coil of the apparatus, by Appellant's witnesses, Professor Booth and Professor Rogers, who obtained fat acids and glycerine with no appreciable acroleine.

And by the unimpeachable testimony of Graham, Hale and Meyer, in their letters to Tilghman.

EXHIBIT GRAHAM, RECORD p. 1018.

"* * *The well defined character, undisputed novelty, and valuable nature of your invention.* * *"*

EXHIBIT HALE, RECORD p. 1035.

"* * Ever since I first *saw it in operation.* * * *"*

*" I am fully convinced of its practicability and that it effects a " saving over the other methods now in use, which I have no doubt it " must in a short time entirely supersede. * *"*

EXHIBIT MEYER, RECORD p. 1036.

" * * The favorable opinion I formed on first *seeing your pat- " ented process, * * is entirely unchanged and greatly strength- " ened by subsequent investigation."

The facts as to why the attempts to introduce the continuous apparatus into use at Moinier's factory failed, are set out by Tilghman in the supplementary testimony.

RECORD pp. 1009-10-11.

Q. 7. State your knowledge of the trial of the coil apparatus at Moinier's works, in Paris.

RECORD pp. 178-64.

Ans. By the terms of the first temporary agreement with Jaillon & Moinier, dated March 4th, 1855, (R. p. 282,) a coil apparatus was to be constructed to put them in "a * * * position to judge of the efficacy and reality of the invention." This apparatus was made for them at the tube works of Gandilott & Co., near Paris, but the wrought-tubes were so bad that they did not even stand the test pressure with cold water, so the whole apparatus was abandoned at once, without trial of the process, and this wsa the whole story of the first apparatus. The small coil apparatus which I had been exhibiting in action to many scientific men and manufacturers in London, was then sent over to Paris and put into successful action at Moinier's works on all the varieties of fats; it was the only coil apparatus, such as directed in the patent, that was ever used there. In consequence of its successful action, a second agreement was made with this firm on July 24th, 1855, a copy of which is here presented as Exhibit " 2nd," Moinier's agreement (R. pp. 1036-7); on executing this second agreement, it was promised that they would order a coil apparatus to be made under my own superintendence in England, where many manufacturers were perfectly familiar with such work.

Such an order, signed by Moinier, dated the same day with the agreement, was accordingly given me. The original paper is here produced and marked Exhibit "Order for Coil," (R. p. 1037). I had the coil made as directed and tested in my own presence by Perkins, of London, and he was about to complete the apparatus by surrounding the wrought-iron tubes with cast iron, a process in

which he had great experience, though involving considerable risk of burning the tubes, if improperly performed.

Mr. Moinier protested against Perkins' price for the casting as exorbitant, and assured me that he would have the casting done at Paris on much lower terms, and ordered the wrought-iron apparatus to be sent over to him. This was done, and it then turned out that the Paris iron founderies asked for more per pound than Perkins, and refused to assume any risks of injury to the iron tubes in the process of casting, which they had never tried before. In this dilemma Moinier, after considerable delay, decided he would cast in the tubes with zinc in the place of cast iron, as zinc melts considerably below red heat. This, if properly done, would have avoided all the risks of injury to the iron tubes. As it was, however, the zinc was not poured into the mould in a melted state, but was kept in a state of red-hot fusion for many hours on the tubes, with the result of perforating them in many places. This property of highly-heated zinc to dissolve wrought iron is well known in the arts. This was the end of the coil apparatus No. 2, untried like the first. This is the only time melted zinc was used in connection with the coil apparatus, and is the sole basis of Moinier's assertion that the process itself was worked with fat and water at a temperature "which certainly much surpassed that of melted zinc." (R. p. 305).

After the destruction of coil-apparatus No. 2, Moinier was much discouraged, and, as his firm fell into pecuniary difficulties at the time, they did nothing further with the process for some considerable interval, during which I kept him informed of the results I was obtaining at the factory of Price's Patent Candle Company, in London, in working the process in the simple digester form of apparatus at lower temperatures and pressures than used in the coil apparatus. It was during this interval of inaction at Moinier's works that Moinier, in July, 1857, wrote the letter (Record, p. 281) urging me to sue De Milly, who was actively working our process, showing that although his own ill luck in making two-coil apparatus was then fresh in his memory, yet his belief in the reality and value of the process itself was, nevertheless, perfect. A year later, when Moinier agreed, September 13, 1858, in partnership with Leroy. (Record p. 325), to resume the trial of my process, although he had full knowledge of the successful working at Price's factory, in London, of the digester form of apparatus at lower pressures, yet the vastly increased first cost of that form of apparatus in proportion to the amount of fat decomposed, made him adhere to the use of the high pressure apparatus.

To obtain still greater cheapness, however, the form of apparatus described in the patent was entirely departed from, and the use of a few cast-iron tubes of large diameter was attempted to be substituted for a long wrought-iron tube.

No accident prevented the successful starting of this third apparatus, which for some time produced fat acids and glycerine of good quality and in considerable quantities, but the unfitness of cast-iron for such work was soon proved by the successive cracking and leaking of one cast-iron tube after another, so that the apparatus was soon disabled. M. Moinier's statement that this last apparatus was undertaken in consequence of my return to Europe after successfully introducing into practice into the United States, a new improvement of filling the tube with little nails, called "points de Paris," is erroneous in every particular. I had never left Europe in the interval at all, as he well knew, as I had been in frequent intercourse with him all the time through Fountainmoreau.

The assertion, (Rec. p. 306, line 22), that the tempting novelty proposed in 1858 consisted in filling the tube with little nails is disproved by his own letter to me (Rec. p. 1037), three years previously, ordering the second coil-apparatus above described, as obtained from Perkins; he there specifies that "all these tubes should be filled with little nails;" "tous ces tuyaux deviont etre remplies avec des petit clous." This shows how unreliable was his recollection in 1863 of what took place five years previous. I must pronounce as equally erroneous his entire statement that the small coil apparatus sent from London failed to produce fat acids and glycerine.

The successful working of that apparatus, in producing fat acids and glycerine, was fully admitted by him at the time. I remember his very words on one occasion, inspecting a sample just produced from the coil in which the fat acids crystallized in an unusually distinct manner. *Ah! cela est tres bien decomposé!*

The fat acids produced by the small coil apparatus were tested under his direction in every possible way. They were cold-pressed, hot-pressed, and made into finished candles of excellent quality.

As for the production of glycerine, we concentrated quantities of it, and worked in the laboratory at various modes of purifying it with animal charcoal, and produced it pure and white.

The experiments with the small coil apparatus are those mentioned in the formal agreement of July, 1855, which states that the firm of Jaillou, Moinier & Co. and myself, "had made experiments on the process, which, though not yet entirely finished, had nevertheless given results sufficiently satisfactory," etc.

RECORD, P. 1037.

This language would never have been used as to a process which never succeeded in producing either fat acid or glycerine, as Mr. Moinier now testifies, nor would a formal agreement and con-

siderable payments be made to secure a process which he now says "only damages fatty bodies without decomposing them."

I cannot confirm M. Moinier as to his asserted reserve in only watching our experiments with said coil apparatus. I remember several times, on coming to the factory in the morning, finding the coil working on samples of fat of nature unknown to me by direct order of M. Moinier to his own workmen. At the time, I was much pleased at the interest he took, and thought it not only natural but highly desirable that he should test it on every variety of fat, and only regretted that he did not give such experiments the benefit of the presence of my brother or myself to insure their being correctly carried out.

This was indeed the only occasional drawback on the success of the experiments with the small coil apparatus at Moinier's works. It would work right and give perfect decomposition as long as my brother or myself were by to watch that the heat and the pressure on the outlet valve were both kept as high as directed in the patent, but the French workmen were so ignorant as to be very much afraid of the apparatus, and on returning to it after any short absence, we often found they had reduced either the heat or pressure, frequently both, and were allowing the apparatus to run on half empty, producing imperfect decomposition and acroleine.

It was in this way that the process was mismanaged by these same workmen, when the jurors of the Exhibition in Paris of 1855 came to Moinier's works to see it in operation. I had been waiting in Paris for weeks to meet these jurors and show them the working of the process myself, and M. Moinier, who was in constant intercourse with them, promised he would give me due notice of their visit. I had brought with me from England a complete series of the products of my process to put in the Exhibition, for which I had secured space, but Moinier persuaded me not to enter them there, but reserve them to show the jurors when they saw the apparatus working at his factory.

The result was that the jurors were brought to the factory at a time of day that I was regularly absent, and, judging from their report, (Record p. 911), must have seen the process botched by the workmen, and I never heard of their visit until several days after it had taken place."

Tilghman's rational and consistent account of the negotiations with Moinier and the experiments conducted during such negotiations is confirmed by Moinier's own actions, which are entirely irreconcilable with his account of the results of these experiments given ten years later in his testimony of 1867.

If the experiments had "never produced fat acids and glycerine," it is plain he would not have persisted in repeating them for

months together, at a large expense, and then, after a year's interval again recommence them, paying the patentee each time for the privilege of doing so.

Moinier's letter to Appellant's agent, Fontaine Moreau, July 17, 1857, stating "that De Milly works by the Tilghman process," and urging complainant to sue De Milly for infringement, shows that at the date of the experiments Moinier regarded it as a real and efficient process.

RECORD 280, p. 1.

OFFICE FOR PATENTS OF INVENTION AND REGISTRATION OF DESIGNS,
39 RUE DE L'ECHIQUIER, PARIS—4 SOUTH STREET, FINSBURY,
LONDON, 18TH July, 1857.

R. A. TILGHMAN, Esq.:—

DEAR SIR: I cannot do better than to forward you the letter I have just received from M. Moinier, in answer to my queries relatively to the use M. de Milly was making of the patent infringing your process.

Yours, very truly,

[Signed] L. DE FONTAINE MOREAU.

[Translation.]

SOCIETE GENERALE DE STEARINERIE,
LA VILLETTE, (NEAR PARIS) 17TH July, 1857.

MY DEAR FRIEND: I received your letter of yesterday, and I have to say that you have very well explained the position of De Milly, who cannot be prosecuted for infringement except by Mr. Tilghman, while, as you have well said, we are without qualification or right to do it.

Not only does De Milly *work* by the Tilghman process, but also he has *sold* to *many candle* manufacturers, amongst others to MM. Petit & Lemoult, the right to work his patent in France, in their factory at Grenelle.

Mr. de Milly has also sold in *Belgium* and in *Austria*, so that while the Messrs. Tilgman are in London and suspect nothing, Mr. de Milly reaps a *harvest in selling* that which he has *stolen from them*.

What to say of all this so long as the Messrs. Tilghman are content to suffer themselves *to be robbed?*

You know De Milly; he does not lose his time; so he is more and more eager to offer his processes; he has offered *them to us many times*. If the Messrs. Tilghman wish to draw any profit from

their patent they ought to prosecute him for infringement as soon as possible.

Let them think of it seriously!

I am too much interested in the question to admit of my giving them advice which might perhaps be misinterpreted.

I must be content with wishing that Mr. Tilghman should have the courage to *defend his intellectual property, that is to say, his honor*.

I wrote to you yesterday, to beg you to execute a commission for my wife; but you will, of course, understand that you are only to attend to it if entirely convenient to you.

Your very devoted,

(Signed,) MOINIER.

Before March 2, 1865. As Moinier's story carries its own refutation with it, it is here arranged in the order of date.

Moinier had seen at Appellee's laboratory, in London, the coil apparatus, and samples of fat acid and glycerine, said to be made with it.

Moinier, 6th cross-interrogatory and answer. Record, p. 307.

March 2, 1855. A preliminary agreement in writing was made between Tilgh- and Moinier, providing that after experiments had been made "*to enable Moinier to judge of the efficacy and reality of the invention*," a contract for the sale of the patent should be executed before a notary.

Moinier's letter. Record, p. 282–3.

Between March 2, and July 2, 1855 The coil apparatus was brought to Paris, and worked at Moinier's factory. Many experiments were made with it. It was worked both by hand and by steam power.

Moinier, 7, 8, and 9 cross-interrogatories and answers. Record, p. 307.

July 24, 1855. A formal contract of sale was made before a notary. 15,000 francs were paid to Tilghman.

Moinier 10th cross-interrogatory and answer. Record, p. 308.

January or February, 1856. After several attempts to get a large apparatus satisfactorily constructed in Paris, which occupied about six months after the date of the contract, it was annulled by consent of both parties.

Moinier, 9th Int. and Ans. Record, p. 304.

July 17. 1857. Moinier writes to Appellee's agent, Fontainemoreau, advising Tilghman to sue De Milly, who is infringing his patent and robbing him.

Moinier's letter. Record, p. 281.

September 13, 1855. The patentee having returned to Philadelphia, a second written contract for sale of the patent was made between his agent Fontainemoreau and Moinier, Leroy & Durand. 12,000 or 15,000 francs were paid to Tilghman.

Moinier, 16th Int. and Ans. Record, p. 306.

November 17, 1859. Suit is brought by Moinier against Tilghman, absent in Philadelphia. He suppresses the fact that there was a *written agreement* which would have spoken for itself, and three times falsely asserts that the agreement of September 13, 1858, given in full, Rec. 325–7, was *verbal*, and claims that it should be annulled, and 25,000 francs damages awarded. Record, p. 314.

December 19. 1859. Judgment by default for want of appearance, awarding 2,000 francs damages, to be collected by personal imprisonment. Record, p. 314.

February 9. 1860. Compromise between Tilghman's agent, Fontainemoreau, and Moinier, by which the suit and judgment are vacated, the contract of September 13, 1858, annulled, and 1,000 francs paid by Moinier to Fontainemoreau, and the patent is reconveyed to Tilghman. Record, p. 328.

August 21. 1867. Moinier, examined on interrogatories by Mitchell, testifies that in none of the experiments made, eight to twelve years previously, was any fat acid or glycerine produced (10th, 14th, and 16th int.). That it is not true that water at a high temperature and pressure will decompose fats, and produce fat acids and glycerine (10th x Int.), and that Tilghman was mistaken in supposing so (12 x Int.).

Moinier was then out of employment. His company, "General Company of Stearinery," was broken up, and another concern Parisian Company of Stearinery, was in possession of their factory, books and papers (1st and 2d Int., Record, p. 303).

Now Moinier's story in 1867 as to the uniform failure to produce any fat acid and glycerine in 1855–8, is simply incredible in face of his own business acts, letters and payments of money at the

time, all of which show a persistent belief in the "the reality and efficiency of the process."

The French jury of 1855 (Record, p. 211), who saw the coil apparatus in operation at Moinier's factory, say not a word as to its failure to produce fat acids and glycerine; they merely speak of the product as "not being deodorized," and having a "strong odor of acroleine."

And we know from the experiments of Appellant's witnesses, Mitchell and Verdin, that this smell is produced, *together with fat acid and glycerine*, whenever from accident or design the tubes are permitted to become partly empty of the mixture, so that some of the water vaporizes and leaves the fat dry. And we know from Booth and Rogers, that this bad result does not occur when proper care is taken.

The failure of Tilghman at Paris, was merely a failure to sell his patent to Moinier on satisfactory terms, a failure consequent partly, upon the difficulty of getting a peculiar apparatus properly constructed and worked by foreign workmen, and in perhaps still greater degree, upon the peculiarities, mental and moral, of the party he had to deal with, and which appear in sufficient relief in Moinier's own testimony.

SAFETY AND COMMERCIAL PRACTICABILITY OF THE COIL APPARATUS.

It is urged by Appellees that the coil apparatus workings at the pressure recommended by Tilghman would be dangerous to human life and constantly liable to explode. Record p.

Another objection to its utility is the claim made by some of Appellees' witnesses, that such an apparatus could not be construdct of sufficient capacity to be practically employed in the process of manufacture. Record p.

The table Record p. 25, which is the only new evidence introduce by Appellees in this suit, shows at a glance, that with an apparatus of the dimensions described by Tilghman, viz, ½ inch bore and 6¼ inch thickness of sides would be *absolutely safe*, since in a pipe of an inch in diameter sides of only $\frac{3}{10}$ of an inch are required to resist a test pressure of *8,000 lbs. per square inch.* The same table shows it to be perfectly practicable to use tubes of 7, 8, and more inches in diameter without exceeding their limits of perfect safety.

Appellant's witness, Joseph Nason, an engineer, who has used for many years tubes containing water at lead melting heat, proves that Tilghman's coil apparatus is entirely sufficient for the operation, and is a *safer* apparatus than the common form of boiler working at one hundred and eighty pounds pressure.

RECORD p.

Q. 5. Have you read, and do you understand, the descriptions and drawings of the coil apparatus in the patent of R. A. Tilghman, No. 11,766.

Ans. I have read the specifications and examined the drawings, and understand them.

Q. 6. Please state whether an apparatus constructed in accordance with said description, would or would not be a safe practical apparatus for heating the materials to a lead melting heat; and state what difficuity, if any, would be experienced in operating said apparatus at such temperature.

Ans. With ordinary care, I should consider it *perfectly safe.* I do not see that any practical difficulty would be incurred in its operation; so long as the temperature be limited to the melting point of lead, an apparatus as strongly constructed as those with which I have been familiar would be *almost absolutely secure against explosion.*

Q. 7. How would the safety of such an apparatus, used at lead melting heat, compare with that of an ordinary form of steam boiler at a pressure, say of one hundred and eighty pounds, and what would be the relative effects in each case in case of explotion, if one should occur.

Ans. I should consider such an apparatus *much the safer of the two;* first, because its margin of strength beyond the strain to which it is subject is many times greater; and second, because in the event of a rupture or explosion the consequences would be very much less serious in case of the tube than in the case of the boiler. When an explosion occurs in a tube of the small dimensions previously stated, it is scarcely ever attended with more serious consequences than the temporary interruption of the work, and the expense of repairs. I will not undertake to state the consequences of the explosion of a steam boiler of any considerable dimensions, under the pressure of 180 pounds to the square inch. In regard to the effect of the explosion of such tubes when working at temperatures high enough to cause their rupture, I can speak from a good deal of experience. I have often seen ruptures from over-heating and the result has usually been little more than a slight disturbance of the brick-work, or materials immediately contiguous.

Mr. Tilghman, in his new testimony, gives his reasons for adopting the coil form, and shows that it is not only as safe but much safer at its high pressure is the ordinary boiler at an enormously less heat.

RECORD, p. 1009.

"* * * When in London, in 1847, I had found Perkin's house warming apparatus, consisting of coils of hundreds of feet of pipe containing water at the temperature of melting lead had long been in extensive domestic use there. On returning to London in 1853, I found the same apparatus largely used for heating bakers' ovens. As I thus found such heats and pressures were perfectly practical and safe as well as economical, I thought I was bound to describe my invention in what I then believed to be the best mode of carrying it out, and that as I was the discoverer of the chemical fats, I could then claim broadly as my process, the use of water highly heated and under pressure to decompose fats, no matter what temperature or apparatus was used.

Q. 5. After your experience, what is your present view as compared with lower temperatures?

Ans. I think the high pressure apparatus is much more economical both in the first cost and in the expenses of working. Its principal disadvantage is, that ordinary engineers are not familiar with its management, and consequently, dislike it. *As to its safety compared with the so-called low pressure apparatus used in Cincinnati, say three hundred pounds per square inch (over double that used in locomotives), the testimony of Mr. Mason agrees with my experience and expresses my opinion entirely, viz; the bursting of a long narrow pipe filled with water at lead-melting heat, opens but a few inches of the weld and leads only to a hissing escape of steam till the pipe is empty; the quantity of heated water is so small, and escape of steam is so gradual, that there is nothing like an explosion, and no mischief is done. Whereas a common boiler containing tons of water at 100 pounds pressure, bursts suddenly with explosion like a bombshell, producing destruction all around.*

Q. 6. Why did you, at a later period, introduce apparatus working at lower temperature and pressures than recommended in your patent?

Ans. From my experience in France and England, I came to the conclusion that I could more readily get my process adopted by manufacturers, if I yielded to their general, though uninformed prejudice against the higher pressures. In France, at Moinier's, the workmen were so afraid of the apparatus, that I could never trust

them to work it by themselves. At Price's factory in London, where I could have gotten plenty of workmen familiar with Perkins' apparatus, using the same pressure, the same fear of high pressure affected the managing director, Mr. Wilson, who refused to allow the coil apparatus to be erected in their works, although it was recommended as the safest and best form of apparatus by their own consulting engineer, Mr. Edward Cowper, to whom I had exhibited it in action. I therefore offered to Mr. Wilson, to erect for them, apparatus to work at any pressure they would be willing to use, from twenty-five pounds to the square inch upwards, telling him that the lower the pressure, the more expensive would be the apparatus. He consented at last to use 225 pounds of pressure for an apparatus to be located in a part of their grounds distant from other buildings. This was put up and worked in 1856, and is the one referred to in Mr. Pillaus Wilson's letter of July 13th, 1865, page 353, Record 340, as being still in use.

In the presence of this testimony it is impossible to doubt not only that the continuous high pressure and quick treatment apparatus recommended by Tilghman, is safe, but that it is enormously safer than any other form that can be used.

As to the capacity of such an apparatus, it appears with the precision of a mathematical demonstration, not only that it could be constructed of a capacity for work equal to the Wright & Fouché apparatus used by Mitchell, but that it could be so constructed as to enormously exceed such capacity without the least risk.

TILGHMAN, RECORD p. 1015.

Q. 14. What size of coil apparatus would be required to decompose the same quantity of fat per week as the Wright & Fouché apparatus used by Mitchell?

Ans. The Wright & Fouché apparatus used by Mitchell is stated by Jos. T. Verdin, R. 87, xQ. 160, 161, to work 1,200 lbs. fat at each charge, and to work 12 charges per week, equal to 14,400 lbs. per week of six days, or 2,400 lbs. per day, or 100 lbs per hour of a continuously working machine.

The coil apparatus used by Professors Booth, Rogers, and Bridges, was 180 feet long, of tube one-half inch in bore, and it decomposed sixteen pounds of fat per hour; it would therefore require 6¼ times this length, or 500 feet of such tube to decompose 100 lbs. of fat per hour. I have often seen Perkins' house-warming apparatus in use in London with 600, and even 800 feet of such tube containing water, and constantly subjected to the same heat and pressure required here. If the tube was of one inch bore, like

that made by Perkins for Moinier, only 125 feet of it would be required. Of tube 2 inches in bore, 31¼ feet would be required. Of tube 3 inches in bore, 14 feet would be required, and the sides of such 3 inch tube would require to be 1½ inches thick to make it of the same strength as the tube specified in the patent. The manufacturers in England who made Perkins' apparatus, offered to make for me tubes 4 inches in bore with sides two inches thick, and to guarantee that they would stand the test pressure.

Is it possible to doubt in the face of this testimony, that the coil apparatus is not only safe, useful, and practicable, but that it is, as Tilghman thought it to be when he took out his patent *the best* form of apparatus for carrying into effect his invention.

Ignorance and prejudice prevented its adoption by the manufacturers in this form, and they utilized the old saponification boilers, etc., to carry out the new process.

Even in these devices the gain over the old methods of treatment was so great as to entirely supersede them, but who can doubt that when the time comes at which competition shall cut down the margins of profit, Tilghman's advice as to the best way of carrying out his process will be called to mind and used to revive the industry.

WHAT TILGHMAN INTENDED TO PATENT.

Much having been said about the extent of the Patentee's knowledge at the time of his invention, and an attempt made to construe the language of the specification rather by what counsel argue to have been the extent of Mr. Tilghman's information, than by the ordinary signification of the language used, Tilghman was examined in this suit chiefly on this point. (R. pp. 1008, 1011, 1012, 1013, 1014, &c.) (ante, pp. .) Counsel can no longer pretend that the Appellant was, in 1854, ignorant of the effect, on fats of super-heated water of a temperature lower than that *recommended* in the patent; and the *intention* of the Appellant at that time is clearly expressed in his correspondence with the office. Record, p. 995.

ATTORNEY'S LETTER.

Philadelphia, August 7, 1854.

To the Commissioner of Patents:

SIR: I have received yours of August 5th, stating that, "on receipt of the model," the application of R. A. Tilghman for a pat-

ent for an improvement in "treating oils," etc., would be taken up for examination in its order.

I beg to submit that this is a case which does not admit of representation by model, as the invention, or, more properly, the discovery, consists in the observation that, by applying a certain amount of heat and pressure to a mixture of oil and water, or watery solution, certain chemical changes take place in the constitution of the oil. In his specification the inventor has given a drawing and description of an apparatus in which the process may be conveniently carried on; but he expressly states that he "does not intend to claim said apparatus as forming any part of his invention." In fact the *form of apparatus in which* the materials are treated, according to the invention, *may be indefinitely varied* to suit the ideas of the constructor, the only essential point being that it shall be capable of withstanding the necessary heat and pressure. A model of the form of apparatus represented by the drawing would be worse than useless for the purpose of illustration and explanation, inasmuch as the essential parts are the internal passages and connections of metal tubes, pumps, an valves, incapable of being shown by model. To furnish *it* as "a model of his invention," when in his specification he has expressly declared it *forms no part* thereof, *would be manifestly contradictory and absurd.* In conclusion, I would urge: 1. That it is, in the nature of things, impossible to furnish a model of that which does constitute this invention, viz, the application of heat and pressure to mixtures of oil, water, etc,, to produce certain results; and 2. That the inventor cannot properly be asked to furnish a model of apparatus which he has declared to form no part of his invention.

I therefore request that this application may be placed upon the list for examination without a model, and that the dicision of the office upon this point may be communicated to me.

Very respectfully,

B. C. TILGHMAN,

10 Prune Street, Phila.

With this letter as a commentary, and the above referred to testimony as to his knowledge of the art setting right the deductions made from his assumed ignorance, the language of the specification may safely be read in its ordinary significance *and* the intention of the Patentee construed to be, to patent *the process* and not the apparatus described.

What Tilghman claims is that the thing patented is *the process* of making fat acids and glycerine from fats by the action of superheated water (water at a high temperature and pressure), *which process* may be carried out in any vessel adapted for such use, and

that the apparrtus described forms no part of the patent, and that the process could be carried into practical effect by the apparatus described. Appellant's position is, that he and his licensees, as part of the public, were at liberty to use, for the purpose of working his invention, any and all of the means and appliances, vessels and machinery, known and in cammon use in the arts at the date of his patent. And that, in using such public machinery to work his patented invention, he is working it by the "means contemplated in the patent," inasmuch as the existing state of human knowledge and the arts is to be taken as the basis of this and of every patent, and is to be understood as being referred to, as distinctly as if expressly mentioned in the specification.

A patentee need not expressly claim the right to use a common steam engine to drive his machinery, or to use coal to heat his furnaces. He has a right to use everything that the public can freely use, and his own invention in addition thereto. Now, the testimony shows that Appellee, from the very beginning, intended to use, for the purpose of working his process, any and all kinds of vessels and machinery known to the arts and suitable for such use.

It is proved from the letter of Appellant, dated July 20, 1857, which was called for and put in evidence (R. p. 415), that there was at that date in practical operation in London, at the works of Price & Co., Appellee's licensees, a common iron boiler, lined with copper, 30 feet long by 32 inches in diameter, decomposing charges of 2½ tons of palm-oil, perfectly, into fat acids and glycerine, by the action of water, at a temperature and pressure of 220 to 225 pounds per square inch in 4½ hours. This letter also states that agitation and mixture of the fat and water, by injection of free steam, was contemplated, and would hasten the decomposition.

It is also in proof that Appellant put up an apparatus in Philadelphia in 1859, and another in Cincinnati in 1860, both precise copies of old well-known machines used in this same art, and that in both the process has been successfully worked, in one for over two years and in the other for nine years, and up to this day.

In 1862 Appellant put up for C. T. Jones, in Cincinnati, another form of apparatus, also well-known and used in the arts, and in this the process has been steadily and successfully worked up to this day. Since that time other similar apparatus have been put up and worked in Cincinnati, Louisville, St. Louis, and New York,

and Mr. Mitchell testifies there were, to his knowledge, in 1867, ten factories in the United States working under license from Appellant and not one, excepting himself, working the water process without license from Appellant.

In order of date, therefore, it appears that in—

August, 1854, Appellant states to the Patent Office that "the form of apparatus may be indefinitely varied."

October, 1854, Appellant states, in the Patent itself, that the "apparatus described is no part of his patent."

July, 1857, an old form of apparatus is in practical use in London, on charges of 2½ tons each.

September, 1859, an old form of apparatus is in practical use in Philadelphia.

January, 1860, a similar apparatus is in practical use in Cincinnati.

1862, a different apparatus, but also old and well known, is in use in Cincinnati, on charges of 6,000 pounds.

In 1867 ten factories in the United States, working the process under Appellant's license, and no one except Mitchell working without his license.

Is it any answer to this mass of direct proof to show that the *process has* not been worked (not that it *can* not be worked, for we have shown that it can) on a manufacturing scale, in some one particular form of apparatus? We claim that *the process* carried on in *any vessel* whatever, is still the exclusive property of the Appellant. If the machinery described in the patent is "*capable of carrying the process into practical effect*," its importance will cease there.

PERKINS' SCUM, DEFENDANTS' EXHIBITS, C. D. AND E., RECORD p. 393—9.

These exhibits do not pretend to describe any process for making fat acids or glycerine. They state that the fat used to grease a steam cylinder was found to be "changed" into a hard, waxy scum, which, when chemically examined, "resembled Chevreul's acids of fat" in two properties—solubility in alkalies, and solubility in alcohol; and also had other properties—not melting in boiling water, and insolubility in ether—which are admitted by Defendants' witnesses to be entirely different and opposite to the properties of fat acids.

The exhibits do not assert the scum *to be fat acids*, but, on the contrary, afford positive chemical proof that it was *not fat acids*.

Glycerine is no where mentioned or alluded to. *The only mention of fat acids* is in the following description of the properties of the changed fat:

APPELLEES' EXHIBIT E., RECORD p. 397.

"It does not melt in boiling water, but at a higher heat melts, "and ultimately burns like fat. It is rather lighter than water; it "dissolves readily in alkalies—more readily, I think, than fat, "*and in this respect resembles Chevreul's acids of fat*, as well as in "its solubility in alchohol; the alkaline solution is turbid. It is not "soluble in ether, or very slightly so; when burnt, it leaves an ash "consisting chiefly of carbonate of lime."

Appellee's chemical experts admit that there is no fat acid known to chemists which possesses the two properties of the scum, viz.: not melting in boiling water, and insolubility in ether.

Appellee's expert, Dr. Smith. Record, p. 821.

Q. 124. Did you ever see, hear of, or read of a free fat acid of oil or tallow which would not melt in boiling water, and was insoluble in ether or nearly so?

Ans. I never did.

Q. 124½. Can you, as a chemist, recognize a substance described as being insoluble in ether, or nearly so, to be free fat acid of oil or tallow?

Ans. So far as my memory serves me, I should say not.

Appellee's expert, E. S. Wayne. Record, p. 865.

Q 169. Is it anywhere stated in said exhibit that the "changed fat," or any product from it, "resembles Chevreul's acids of fat" in any other respect than "solubility in alcohol, and dissolving in alkalies more readily, I think, than fat?" If so, quote the words.

Ans. No, it is not.

Q. 170. Are there not other properties of the "grayish substance" mentioned, viz.: "That it does not melt in boiling water, but at a higher heat melts, and ultimately burns like fat," and that "it is not soluble in ether, or very slightly so?"

Ans. Those properties of a grayish substance are mentioned.

Q. 171. Did you ever see, hear, or read of any acids of fat, obtained from oil or tallow, which would not "melt in boiling water," and which was "not soluble in ether, or very slightly so?"

Ans. No.

Q. 172. Would chemists generally recognise as fat acids of oil and tallow (meaning thereby free fat acids) a substance which is described as being soluble in alcohol, and in alkalies, but not melting in boiling water, and insoluble in ether, or nearly so?

Ans. They would not.

Q. 173. Is it stated in said exhibit that any other portion of the "changed fat," besides the "grayish substance," resembles Chevreul's acids of fat? If so, quote the words.

Ans. It is not.

MITCHELL, RECORD, p. 761.

Q. 83. Is fat acid soluble in ether?

Ans. I believe it is.

Q. 84. Did you ever see any fat acid, or know of the existence of any, which is not soluble in ether?

Ans. I cannot bring to my recollection any experiment to test the solubility of fat acids in ether, but I have no doubt I have made such, or seen them made, and therefore believe as before stated.

Q. 85. If all fat acids are soluble in ether, and if you found that a fatty substance was not soluble in ether, you would be satisfied that it was not a fat acid, would you not?

Ans. I should be satisfied it was not a free fat acid, but as it is my opinion based upon experiments with ether, which I have either made or seen made, I should also be satisfied that it was not a neutral fat, as that will be dissolved by ether.

SAME WITNESS, RECORD, p. 762.

Q. 97. In your experience as a manufacturer of fat acids, did you ever see fat acids that would not melt in boiling water?

Ans. Not unless they were in combination with some base.

Q. 98. Did you ever see a free fat acid that would not melt in boiling water?

Ans. Not to my knowledge.

SAME WITNESS, RECORD, p. 768.

I never saw any combination of fatty and other substances that did not melt in boiling water, but melted at a higher heat, and ultimately burned like fat; consequently in this respect the properties in Exhibit No. 1 differ from any with which I am acquainted. Fatty acids, I believe, are soluble in ether, and so are neutral fats. If the product of Perkins' engine was not soluble in ether, it could not, in my opinion, be a neutral fat.

Q. 135. You say, "Fatty acids, I believe, are soluble in ether."

"If the product of Perkins' engine was not soluble in ether," could it be a fatty acid?

Ans. It could not, in my opinion, be a pure fatty acid, and the product is not claimed to be such. It is stated "it is not soluble in ether, or very slightly so."

VERDIN, RECORD, p. 789.

Q. 109. Did you ever see a free fat acid that would not melt in boiling water?

Ans. Not when it is entirely free.

Q. 110. Did you evee see a free fat acid that had been separated from impurities by being dissolved to a clear solution in hot alcohol, and afterwards precipitated from the alcohol by cooling, and melted, which would not melt in boiling water?

Ans. I have not.

Q. 111. Do you believe that any such fat acids exist?

Ans. Not if it is pure.

Q. 112. Did you ever see a free fat acid that was soluble in alcohol, and was insoluble in ether?

Ans. I have not.

Q. 113. Do you believe any such fat acids exist?

Ans. I do not.

Appellees' experts cannot testify positively, from the description in the exhibits, that there was any free fat acid in the scum; they merely *infer*, from their present knowledge of the decomposition of fat by water (derived from Appellant's patent,) that there *might* be some.

APPELLEE'S WITNESS, DR. SMITH, RECORD, p. 821.

Q. 123. Do you mean to say that your strongest reason for inferring that the product from Perkins' engine was free fat acid, is your present knowledge that fats will be decomposed into free fat acids and glycerine by the action of water at a high temperature and pressure?

Ans. The strongest inference is, as I stated above, that fat can not be exposed to high heat, pressure, steam, with or without water, without undergoing decomposition.

Q. 134. Confining yourself strictly to the chemical properties of the "grayish substance," as they are described in Exhibit 1, can you name any which would enable you to *testify positively* that said "grayish substance" contained any *free* fat acid whatever? If so, please state the properties.

Ans. None that would enable me to *testify positively* that such was the case, but some that *would lead me to infer* that such ***might be the case.***

Q. 147. You have already stated that none of the chemical properties of the "grayish substance," as they are described in Exhibit 1, would enable you to *testify positively* that it contained any *free* fat acid whatever. I now ask you, which of the chemical properties of the "soft and even fluid substance," described (confining yourself strictly and accurately to the chemical properties described in the exhibit), would enable you to *testify positively* that said "soft and even fluid substance," contained any free fat acid whatever?

Ans. It must be understood that when I answered the cross-question 134, in regard to "testifying positively," I understand by testifying positively to mean, *to know to a certainty*, and with such an understanding I answered the first part of the cross-question 134, but adding in the same answer that there were some properties "that would lead me to *infer* that such *might be the case*," viz., that there were free fat acids present; and for the same reason, while I cannot testify positively about the "soft and even fluid substance," on so short and imperfect a description as Exhibit No. 1, I am convinced that there are even stronger reasons *for supposing* that the soft and even fluid substance contained more or less free fat acid. For further elucidation of my opinion, see answer to cross-questions 125 and 138.

APPELLEE'S WITNESS, E. S. WAYNE, RECORD p. 864.

Q. 165. Please quote the words of said exhibit which announced the fact that fat can be decomposed into free fat acids and glycerine by water in a high temperature and pressure?

Ans. The exhibit does not say change of fat by Perkins' engine by the action of water, heat, and pressure, into fat acids and glycerine; it merely alludes to a change of fat. Upon the examination of the report, *and the knowledge I have of the decomposition of fats by heat and water, the only inference I can form,* is from the facts mentioned in the paper, that both fat acids and glycerine were produced in the decomposition or change named.

Appellant's chemical experts testify positively that the chemical properties of the scum prove that it was not fat acid.

PROFESSOR J. C. BOOTH, RECORD, p. 593.

Q. 64. Explain in detail what fact is announced in Exhibit No. 1, entitled "change of fat in Perkins' engine by water, heat and pressure."

Ans. The paper states that a mixture of olive oil and tallow was used to lubricate the piston of a steam engine, and was thus exposed to the action of steam at a high temperature and pressure, was carried on by the steam and produced in the condensed water a scum, differing in properties from the original fat. This scum was examined chemically, and its properties are described. The writer

states that it dissolves readily in alkalies, "more readily, I think, than fats, and in this respect resembles Chevreul's acid of fat, as well as in its solubility in alcohol." It is also stated that the substance is not soluble in ether, or very slightly so, that it does not melt in boiling water, and that when burnt it leaves an ash consisting principally of carbonate of lime.

Each one of these last three named properties proves conclusively that the substance was not a fat acid or oil of tallow, for, on the contrary, a fat acid of oil and tallow is very soluble in ether, melts far below the heat of boiling water, and when burnt leaves no ash. The properties in which the scum is stated to have resembled Chevreul's acid of fat, namely, solubility in alkali, and solubility in hot alcohol, are *indecisive resemblances*, inasmuch as they belong also to neutral fats, and to soaps to a certain extent, the difference being one of degree only.

The properties described, which are distinct, positive and decisive, and not mere resemblances, namely, insolubility in ether, melting point above 212° F., and leaving an ash of carbonate of lime, are *entirely different from the properties of fat acid.* This proves conclusively that *the scum was not fat acid.*

Q. 65. Have you examined the properties of the fat acids of a mixture of oil and tallow, and can you state from personal knowledge how they compare with those of the scum as described?

Ans. I prepared the fat acid of a mixture of equal parts of olive oil and tallow, and treated it step by step in precisely the same manner as is described for the scum, namely, I dissolved it in hot alcohol, let it cool, and separated the precipitate which formed by cooling, and melted it.

I found its melting point to be 140° F., that it dissolved freely and perfectly in ether. and that when burnt it gave no ash. In all these properties it differed absolutely from the scum as described, which cannot, consequently, have been the same substance. If the scum had been the fat acid of a mixture of oil and tallow, it would have melted far below 212° F.; it would have dissolved freely in ether, and when burnt would have left no ash. It is described as having *exactly the opposite properties, and cannot, therefore, have been the fat acids of a mixture of oil and tallow.*

PROF. R. E. ROGERS, RECORD, p. 675.

Q. 40. Explain in detail wherein the process and results described in Exhibits 1, 2, 3, and 19, resemble, or differ, in principle and operation, from the process and results described in Complainant's patent.

Ans. The important point of difference is that in these exhibits it is nowhere stated that any fat acid or glycerine was produced,

It is, moreover, certain, from the chemical properties described that the *product* was not fat acids. Its resemblance to fat acids in two properties—solubility in alcohol, and in alkalies—is noticed by Faraday; but these properties are possessed by other fatty substances, such as neutral fat and soaps, and, therefore, are *resemblances*, and *only resemblances*, as the author calls them, and are not proofs of the identity with fat acids. The product differs from fat acids in three marked and distinctive characteristics, either one of which is sufficient to prove it to be a different chemical substance. Thus:

1st. The free fat acids are very soluble in ether. Faraday's product did not dissolve in ether, or very slightly. 2d. Fat acids melt at from 110° to 140°, according to whether they are pure stearic, or stearic acid mixed with oleic acid. Faraday's product would not melt in boiling water, 212° F. 3d. When burned, fat acids leave no ash, or the merest trace, if they have been prepared with lime. Faraday's product, when burned, left an ash chiefly of carbonate of lime. It is therefore inconsistent with chemical reasoning, it is absurd to infer that a substance having such unlike, even *opposite* properties, should be of the same chemical nature. With our present knowledge, especially that derived from Tilghman's patent, we can see that if fat and water alone, without any other substance combined with the fat acid, had been exposed to a heat and pressure in Perkins' generator, there would have been a formation of fat acid and glycerine. It is made certain by the statements of Faraday, that lime, in unknown quantity, was also present, and must have been brought in contact with the water and fat, and that it combined with the fat acid of the fat and formed a substance altogether different from a free *fat acid*. Had no lime been present, it is probable that the fat acid might have been recognized and announced as such, in which case Tilghman's discovery would have been anticipated by thirty years. As the facts exist, it is perfectly clear that neither Faraday nor any other chemist, from the year 1823 to 1854, regarded or announced the product described in the exhibits to be fat acids, and consequently the decomposition of fats into fat acids and glycerine by the action of water at a high temperature and pressure, remained unknown until Tilghman's patent.

Appellant's expert shows that the chemical properties of the changed fat as detailed in Exhibit 1 agree closely with those of neutral lime soap.

Professor Rogers testifies that he chemically examined a neutral lime soap made of a mixture of oil and tallow, in the precise way, step by step, as described by Faraday, and found its properties to agree entirely with those of Faraday's product.

DR. R. E. ROGERS, RECORD, p. 677.

Q. 43. Judging from all the properties of the substance as described in Exhibit 1, what do you infer it to have been?

Ans. I infer it to have been a neutral lime soap.

Q. 44. Have you made a chemical examination of the neutral lime soap, made from a mixture of equal parts of oil and tallow? If so, state how said lime soap was prepared, and what its properties are, as compared with those of the substance described in Exhibit 1.

Ans. I saw in Professor Booth's laboratory a neutral lime soap, prepared by heating a mixture of equal parts of olive oil and tallow, with thirteen per cent. of lime and water, in a close copper vessel, at a temperature between the melting point of tin and bismuth. It was a harsh and brittle substance, of a grayish color; it was dissolved by digesting in alcohol, and the clear solution poured off while hot, on cooling deposited a white powder, which, when collected and fused, formed a hard substance having a resemblance to wax, but more brittle and resinous; it was lighter than water; it did not dissolve in hot ether; it did not melt in boiling water at 212°, but at a higher temperature it melted and finally burned like fat, leaving a residue of carbonate of lime; on boiling with alkali it dissolved, giving a turbid solution; and on making a direct comparative trial it was found to dissolve in the alkaline solution more readily than neutral fat. The white powder which precipitaed from the hot alcoholic solution by cooling was a stearate of lime, which is somewhat soluble in hot alcohol, but nearly insoluble in cold alcohol. The fluid substance obtained by evaporating the cold alcoholic solution was an oleate of lime, which is somewhat more soluble in cold alcohol. The neutral lime soap which I examined, therefore, agrees substantially with the substance whose properties are described by Faraday in Exhibit 1. As we know positively that the substance in Exhibit 1 contained lime as well as fat, and as its properties described agree so entirely with those of neutral lime soap, I infer that it was *neutral lime soap.*

Q. 45. Did you burn the fluid substance obtained by evaporating the cold alcoholic solution, (which you call oleate of lime,) and if so, did you obtain any ash, and of what nature?

Ans. I did burn a portion of that material, which left an ash, which ash was the carbonate of lime.

Appellee's expert, Dr. Smith, admits that he is ignorant as to whether the properties described by Faraday are those of a neutral lime soap or not.

DR. SMITH, RECORD, p. 822.

Q. 131. Will not a neutral lime soap, by digestion in hot alcohol, give a solution which, on cooling, will let fall a precipitate consisting of the larger portion of the neutral lime soap dissolved?

Ans. I have never tried this experiment, and cannot answer.

Q. 132. Can you testify positively to the contrary?

Ans. I cannot testify either one way or the other on a point in technical science that I have not experimented with, and about which I am told there is difference of opinions among those who speak of the matter within their own authority, and that of others.

Q. 133. Will not a neutral lime soap dissolve in strong alkalies, making a turbid solution consisting of a solution of an alkaline soap, holding in suspension free lime, which causes the turbidity?

Ans. That I cannot tell, but suppose it might; I cannot refer to any author who seems to have tried the experiment.

Appellee's witness admits that all the lime which existed naturally in the water used in Perkin's generator would combine with the fat and form lime soap, and that if this lime was equal to or in excess of the chemical equivalent of the fat used, all this fat would be converted into lime soap, and there would not be any free fat acid produced.

MITCHELL, RECORD, p. 749.

Ans. 17. Water is never found pure in nature. The most universal impurity being lime; fatty acids having a great affinity for lime, combine with any lime present in the water; and to free the fatty acid from this impurity, we treat it with a small quantity of sulphuric acid to purify it before making it into candles.

SAME WITNESS, RECORD, p. 749.

Ans. 20. I have already stated that lime is almost universally found in water. The treatment of fat in the Perkin's engine, by water, heat, and pressure, would necessarily acidify some portion of the fat, and that portion would combine with any lime found in the water.

SAME WITNESS, RECORD, pp. 766–7.

Q. 122. The whole of the lime existing in the water in the generator would combine with an equivalent quality of the fat acid, and form lime soap, would it not?

Ans. That is my opinion.

Q. 123. If, then, a quantity of lime sufficient to combine with all the fat acid had existed in the water in the generator, the pro-

duct would necessarily have been lime soap, without any mixture of free fat acid, would it not?

Ans. It certainly would; but Exhibit No. 1 shows, in my opinion, that the quantity of lime was not sufficient to combine with all the fat acid and form a lime soap.

Q. 127. And if the quantity of lime in the water had been largely in excess of the quantity equivalent to the fat acid, lime soap, without any mixture of free fat acid, would have been produced, would it not?

Ans. If the quantity of lime in the water was more than sufficient to combine with the acidified fat, lime soap, without any mixture of free fat acids, would have been produced.

DR. SMITH, RECORD, p. 822.

Q. 128. Then the chemical combination known as "lime soap" must have been present in the "grayish substance" in quantity corresponding to the lime found in it, must it not?

Ans. I should say so.

Q. 129. And if the lime found in it was in quantity equivalent to the fat present, the "grayish substance" would have consisted entirely of neutral lime soap, would it not?

Ans. I should suppose so.

Q. 130. The question whether this grayish substance was a neutral lime soap or not would depend entirely upon an unknown fact, viz.: whether the unknown quantity of lime present in it was greater or less than the chemical equivalent of the unknown quantity of fat present in it. Is that so?

Ans. I should say it was.

Appellee's expert, Dr. Rand, testifies (R. p. 906, Q. 143) that ten pounds of Thames water contains lime enough to convert one hundred and eighty grains of fat into neutral lime soap.

It is agreed by counsel, as a matter of general scientific information, that a steam engine evaporates sixty-two pounds of water per hour for each horse power. It is proved by Appellee's witness, Matthewson, a practical engineer (R. p. 738), and not contradicted by Appellant, that a twenty-five horse power steam engine uses about three-quarters of a pound, or 5,250 grains, of fat to grease the piston during ten hours, or 525 grains of fat in one hour, in which time it would evaporate 62×25, or 1,550 pounds of water. This 1,550 pounds of Thames water would convert into neutral lime soap 155×180, or 27,900 grains of fat, which is fifty-three times the quantity used to grease the piston during the time of its evaporation.

It is true that in Perkins' engine the steam is described to be condensed, and this condensed water is pumped back into the generator; but it is expressly stated in the detailed description of the engine, in Defendants' Exhibit 19, that *the cold water* used to condense the steam (and which thereby becomes heated) is ALSO PUMPED INTO THE GENERATOR.

DEFENDANTS' EXHIBIT NO. 19, p.

"The condensor *ll* is a tube of copper about four inches in diameter and twenty feet long, and is *supplied constantly with cold water* from the pump, through the pipe *n n*, which enters the condenser at the lower end, and is discharged at the upper end into the tube *r r*, which, proceeding to the lower part of the apparatus, ascends in a spiral winding of many coils round the bottom of the furnace up to valve *s*, which is also loaded by a variable weight *u*, equal to 700 lbs. upon the square inch, (or about 50 atmospheres;) from the valve *s* the tube descends as at *v v v*, and proceeds to nearly the bottom of the generator, as shown by the dotted line."

It is evident, therefore, that a mixture of *fresh water* and condensed water was constantly being pumped into the generator. What proportion of each was used is not stated.

It is a well-known scientific fact that five pounds of cold water, at 60° Fahr., are absolutely required to condense steam enough to produce one pound of water, the whole six pounds being thereby brought to the temperature of 212° Fahr. But the preceding calculation shows that if the fresh water used amounted to only one-fifty-third as much as the condensed water, or one-two hundred and sixty-fifth part of what was necessary for complete condensation, there would still have been enough lime present to convert *all* the fat used for greasing the piston into neutral lime soap, and to prevent any of it existing as free fat acids.

The best practical proof that the public did not become informed of the process for decomposing fats into fat acids and glycerine by the action of water at a high temperature and pressure, by the publication of these Exhibits in 1823, is the fact that for thirty-one years after (up to 1854, date of Complainant's patent) no mention of such process is to be found in any chemical or technical work on the subject, and that manufacturers continued, year after year, to consume uselessly millions of pounds of lime and sulphuric acid

to produce this decomposition, all of which they might have saved had they possessed the information alleged by Appellees to be imparted by these Exhibits.

Prof. Booth gives a list of ten chemical and twelve technical treatises of dates between 1823 and 1854, which refer to the subject, but do not mention the water decomposition. He gives another list of seven chemical and eight technical works, of dates later than 1854, all of which mention the water decomposition.

BOOTH, RECORD, p. 594–5.

Q. 68. As a matter of chemical history, did or did not chemists become acquainted with that chemical fact from the publication of those Exhibits in 1823? and explain how you form your opinion. Give a list of the chemical treatises you have examined on the subject.

Ans. Chemists did not become acquainted with that fact from the publication of those Exhibits in 1823. When new chemical facts or discoveries are published, they are collected and embodied in standard chemical treatises which represent the state of the science at the date of their publication. To ascertain whether a particular chemical fact was or was not known at a given date, say 1854, I should examine a number of the most authoritative treatises published at or before that date, and if none of these contained any mention of that fact when treating on the subject to which it related, I should then be compelled to conclude that the fact was not then generally or publicly known to chemists.

If, on examining new editions or treatises of a later date, I found that several of them did mention the fact in question, I should then conclude that it had been discovered and first made public in the interval between the dates of the respective treatises.

I annex a list of standard chemical treatises of the highest authority, of dates between 1823 and 1854, which I have examined. They all contain descriptions of the properties of fat and fat acids, and the known methods of producing fat acids and glycerine. None of them mention the fact that fat acids and glycerine can be produced by the action of water on the fats at a high temperature and pressure.

I annex another list of standard chemical treatises of dates subsequent to April 3, 1854, all of which contain mention of that fact.

I therefore infer and conclude that that fact was first made known subsubsequent to 1852, and prior to April 3, 1854.

PROFESSOR BOOTH, RECORD, p. 596.

Q. 71. Please state in general terms the result of your examination of the standard chemical and technical publications?

Ans. None of the technical treatises or chemical works published prior to 1854, contain any mention either of the chemical fact of the decomposition of fat by water at a high temperature and pressure, or of the manufacturing process founded upon it. After 1854, both the chemical fact and the manufacturing process are mentioned in numerous technical publications.

PROFESSOR ROGERS, RECORD, p. 676.

Q. 41. Is the chemical fact which forms the basis of complainant's process, as patented, an interesting and important one, and would its first publication be likely to attract attention, and to be copied into chemical treatises? State what publications you have examined on the subject, and with what result.

Ans. Such decomposition and conversion is undoubtedly a most interesting and important chemical fact, both scientifically and in its practical application to an extensive and useful manufacture; and any clear and distinct announcement of it, especially from such authority as Faraday, could not have failed to attract attention, and to have been copied into the chemical and technical treatises of the period. I have examined the chemical and technical works mentioned by Professor Booth, in answer to questions 68 and 69 and 70, of his direct examination in this case, and find that in those of dates earlier than 1854 there is no mention of or reference to this fact, while all those of dates later than 1854 do mention or refer to it. All the treatises referred to by Professor Booth are standard works of the highest authority in their respective lines.

Appellees' experts cannot testify that the public got this information from the exhibits.

DR. SMITH, RECORD, p. 832.

x*Q.* 196. As a matter of chemical history and record, *did* chemists generally become informed from the publication of Faraday's paper (Defendants' Exhibit 1) of the fact that fats could be decomposed into free fat acids, and solution of glycerine by the action of water at a high temperature and pressure?

Ans. So far as my information goes, chemists generally seem to have paid but little attention to Faraday's paper, and consequently could not have become acquainted with the fact referred to.

In 1865, Prof. Faraday published a book upon the "Chemical History of a Candle," in which he describes the method of manufacturing fat acids, but does not mention, or allude in any way, to the process by water at a high temperature and pressure, supposed to have been discovered and announced by himself, in 1823.

Appellees' witnesses produce the most conclusive proof that the information imparted to the public by these Perkins scum exhibits was merely vague suggestion, and nothing definite or practical.

It appears that M. Werk had a knowledge of them abont 1843, and then told the witness Verdin, that he had learned that water "would do wonders" in the treatment of fats. They had an apparatus made, tried the experiment, and *utterly failed to decompose fats*, or to produce, as far as they knew, any fat acid or glycerine.

APPERT'S PROCESS—THE FIRST HOT WATER RENDERING PROCESS.

Appert's French Patent of 1823, Ex. 14,R., p. 575, was for rendering raw fat or suet into tallow by boiling it with water under pressure, so as to better dissolve the animal tissue. It has been often re-patented since, and is chiefly referred to here as Manicler's Process, patented 1826. Ex. 15, R., p. 575.

Booth, R., 607, Q. 129. Appert's Process in Exh. 14, is for melting raw suet with water, at a temperature of 239° to 266° F., or about ten to twenty-two pounds pressure, for one hour, and the resulting product is expressly stated to be *tallow*, and to be dry and sonorous, and very white. It is not stated that any free fat acid or glycerine is produced.

MANICLER'S PROCESS DIFFERENT FROM TILGHMAN'S.

RECORD, p. 255.

Manicler's patent of 1826 (Appellees' Exhibit 15), is cited by Appellees, but he does not pretend that it describes Tilghman's process, or that it produces or pretends to produce his results. Manicler himself states *nine* times in this patent that he obtains not fat acid and glycerine, but "*tallow*." His experts admit that Manicler *himself* did not even *know* such a result would be obtaind.

DEF. WITNESS, VAN DER WEYDE. RECORD, p. 180.

x*Q.* 108. Did you or did you not obtain a solution of glycerine when following Manicler's prescription?

Ans. I don't know, *neither did Manicler know it himself.*

PROF. WOLCOTT GIBBS, RECORD, p. 29.

Q. 37. What is the condition of the fatty matter after undergoing the process described in this patent (Exhibit 15), is it in the state of a free fat acid, or is it still a neutral fat?

Ans. It is still a neutral fat.

Q. 38. State if there are any positive proofs of this fact contained in this patent itself, and if so, mention them all in detail.

Ans. I will read the statement of the Patentee, viz.:—

"Instead of preparing fatty substance from tallow by digesting with it water as hereinbefore described, the *same results* may be obtained by *melting tallow* in an ordinary boiler, and *adding oil of turpentine thereto* in the proportion of one part by weight of oil of turpentine to about seven parts by weight of tallow, the subsequent treatment of the tallow after being so melted with the oil of turpentine, being the same as if it had been digested by water in the manner hereinbefore described."

I consider this as positive proof that saponification had nothing whatever to do with Manicler's process, but the whole patent very clearly shows that saponification was not intended or even thought of.

APPELLEES' EXPERT, VAN DER WEYDE, RECORD, p. 184.

x*Q.* 134. Do you know whether Bracconnot mixed melted neutral fats with spirits of turpentine, and, after cooling, submitted said mixture to cold pressing? If yea, what was the result of such an operation—was the fat decomposed thereby into fat acid and glycerine, or was it produced in the state of a hard neutral fat?

Ans. The mixture of fat with turpentine will of course *not decompose the fat*, turpentine being a neutral body. It acts only as a solvent for the more fluid oleine, and has the effect of causing the oleine to be more completely removed by pressure from the stearine and margarine. These last two substances were the result. They are hard neutral fats.

PROFFESSOR J. C. BOOTH. RECORD, p. 51.

In comparing "Exhibit 15" with Plaintiff's process, I examined Manicler's patent from the printed specifications issued by the

English Government. "Exhibit 15" describes a process for rendering tallow or raw fat with water under a pressure not greater than one atmosphere. That the object and result of the operation described in said exhibit is only to *render* the fat and *not to decompose it*, are proved from the statements in the exhibit that the solid fat requires great care in pressing to obtain it; that the solid fat obtained is so brittle that candles cannot be made of it without the addition of wax or boiled linseed oil, and that the liquid fat pressed out from the solid might be used as a lubricator, and that the patentee claims throughout that the resultant solid fat was still fat or tallow, by mentioning it no less than nine times in the patent, and he further states that the *same* result as by his process may be obtained by adding to the crude tallow oil of turpentine, melting it and pressing it to separate the solid from the liquid fat. There is not the slightest allusion through the whole patent to a fat acid, or to glycerine, nor to the decomposition of the tallow or fat, but only to the separation of liquid from solid fat. If a decomposition of the fat took place, the liquid fatty matter pressed out *could not* be used to burn in lamps, nor for oiling machinery, for which purpose, the patentee states, his oily matter can be used. If the decomposition of the fat had taken place, the solid fat acid resulting from pressure could be used for making candles without the addition of wax or linseed oil. Since the same result is obtained by melting the crude fat with turpentine in an ordinary boiler and pressing, as by melting, the crude fat with water at a pressure of one atmosphere, and since the so melting with turpentine cannot decompose the fat, and since the resulting products are identical, therefore no decomposition of the fat could possibly have taken place.

PROF. F. A. GENTH, RECORD, p. 89.

IV. MANICLER.

1. Presence of heated water under pressure *not at all necessary* as the admixture of spirits of turpentine produces the same result.

2. Produces, and intended to produce purified *neutral* fats.

3. Produces hard neutral fats "too granular and friable in its texture to be fit for making candles" without admixture of wax or boiled linseed oil.

4. Produces liquid neutral fats, or oil "oleine" suitable for oiling machinery, or burning in lamps.

IV. TILGHMAN.

1. Presence of highly heated water under pressure, absolutely necessary.

2. Decomposes the neutral fats, and produces free fatty acids and glycerine.

3. Solid fatty acids produced not friable, or granular, and fit for making candles without admixture.

4. Liquid fatty acid, "Oleic acid," unfit for burning in lamps, or oiling machinery.

Manicler's was a mere hot water "rendering process," to get the fat free of the cellular tissue by which it is surrounded in the animal; and such a mode of rendering was pursued by the Defendants themselves, from 1844 down to the present time, as a mere "rendering process."

F. Verdin, RECORD, p. 242.

x*Q.* 19. How long have you used Wilson's tank for rendering fats or known of its use?

A. I believe I used it from 1844, and have rendered all my tallow with it.

C. T. JONES, RECORD, p. 34.

Q. 13. [Objected to by Defendant's counsel.] State whether Wilson's process is or is not substantially the same as that described in the first part of Manicler's patent and state also if lard so treated by Wilson's process had been subsequently cold and hot pressed, whether the candles produced therefrom would not be such as contemplated by Manicler's patent, and also like those in Exhibit "M?"

Ans. It seems to me that Wilson's process is identical in principle with the process indicated in the first part of Manicler's patent, according to the copy of the patent marked "Defendant's Exhibit 15."

DANIELL'S BAROMETER.

Appellants' counsel should, perhaps, apologize to the eminent counsel for the Appellees for venturing to suppose that they will seriously urge the Daniell's Barometer Exhibit upon the attention of this court.

In the transactions of the Royal Society (London) for 1832, Prof. Daniell gives an account of some experiments made by him with a water barometer, composed of a glass tube over forty feet long by one inch bore, placed vertically; the lower end of the tube went into the water of a little boiler, so that, by raising steam on the boiler, the pressure forced the water to rise in the long glass tube to its top, which was then sealed up, and the steam allowed to subside, and the water fell to the barometric height. As the water in the boiler had been carefully freed from air by long boiling, it was desired to prevent it from reabsorbing any when cold. (R. p. 398)

The appearance of some drops of an aqueous fluid, of a sweet taste, resembling glycerine, along with carbonaceous matter, *on the top* of this castor oil, after it had been exposed to the air *during two years*, in the cistern of this water barometer, does not present at first sight, to the ordinary mind, any great resemblance to a process for manufacturing fat acids and glycerine, by mixing fat and water, in a close vessel, at a high temperature and pressure, during six or eight hours.

Dr. Van der Weyde, that learned chemical expert of Appellees, however, (R. p. 411, x Q. 71) considers Daniell to have here announced to the world, in 1832, the chemical fact, that water at the ordinary temperature of the air would decompose fat into fat acid and glycerine. Daniell himself published a chemistry, in 1843, in which he describes the common processes for decomposing fats and making fat acids and glycerine, but says not a word of this remarkable discovery which Dr. Van der Weyde discovers him to have made eleven years before. Prof. Booth was examined as to this barometer, and explains it fully. (R. p. 602)

"*Q.* 98. Have you read, and do you understand, Defendant's Exhibit 9, and have you examined the original publication it the Philosophical Transactions?

"*Ans.* I have read, and I understand it; and I examined the original paper in the Philosophical Transactions.

"*Q.* 99. Does Exhibit 9 contain any evidence of a prior knowledge or use of Complainant's process?

"*Ans.* It does not.

"*Q.* 100. Does it contain any announcement of the chemical fact that fat can be decomposed into fat acids and glycerine by the action of water at a high temperature and pressure?

"*Ans.* It does not

"*Q.* 101. Explain what fact is announced in that paper?

"*Ans.* It is said that a stratum of castor oil was placed on the surface of the water, in the cistern of a water barometer, and that after the lapse of nearly two years some drops of a liquid resembling glycerine were formed on the surface of a mucilaginous substance, which had formed on the top of the oil.

"*Q.* 102. Is it anywhere stated in that paper that the oil was ever exposed, in contact with the water, to a high temperature and pressure?

"*Ans.* It is not.

"*Q.* 103. Has that paper any real connection with, or relation to, the process claimed in Tilghman's patent, or the chemical fact on which it is based?

"*Ans.* It has not the slightest.

"*Q.* 104. State whether you have examined Daniell's Introduction to Chemical Philosophy, London, 1843, pages 616, 617; whether it is by the same author as Exhibit 9; whether it contains descriptions of the known methods of decomposing fat acids, making fat acids, and whether it contains any mention of the process of decomposing fats into fat acids and glycerine by the action of water, either at common temperature or at a high temperature and pressure?

"[Objected to, for the reason that the publication referred to in the question is not referred to in Defendants' answer; and that the production of the book is the proper evidence of what it contains or does not contain, and that the question calls for negative testimony.]

"*Ans.* I have examined J. Frederick Daniell's Introduction to the Study of Chemical Philosophy, London, 1843. It is by the same author as quoted in Exhibit 9. The only notices contained in that work of methods of decomposing fats are on pages 616 and 617. On page 616 it mentions that glycerine may be separated from oil or fat by boiling the latter with a solution of caustic alkali or oxyde of lead, whereby soaps or plasters are formed and the glycerine separated. On pages 616 and 617 the stearic, margaric, and oleic acids are stated to be obtained by saponifying stearine, margarine and oleine with caustic potash, and then decomposing the stearate, margarate, and oleate of potassa by muriatic acid. No other method of obtaining fat acids is mentioned. Daniell's work contains no mention of the process for decomposing fats by the action of water, either at common temperature or at a high temperature and pressure."

It it to be noted that no mention is made in the exhibit of *any glycerine* being found *in the water*, nor of any fat acid existing in the oil.

When Dr. Van der Weyde was asked if he could explain why a specimen of the same oil and water, which had been kept in a covered glass vessel during the same length of time, was not also decomposed, (Record, p. 411, x*Q*. 73.) he replies: "Very easily. In the glass vessel, oil and water were at perfect rest. In the barometer they were never at rest, by the daily varying pressure of the atmosphere and the consequent oscillation of the liquids. In the glass vessel *the formation of the emulsion* was not promoted by continuous motion, as was the case in the barometer."

Now, the average daily oscillation of the barometer is less than ½ inch of mercury, equivalent to 7 inches of water; and as the area of the barometer tube is stated to be $\frac{1}{250}$ of the area of the cistern, this would cause an oscillation of the liquids in the cistern, of about $\frac{1}{35}$ inch in twenty-four hours, or $\frac{1}{840}$ inch in an hour, or $\frac{1}{50400}$ of an inch in a minute—a motion which would defy the most delicate micrometer and microscope to detect—and less than the thousandth part of the tremor that would be communicated to a glass of water standing upon a table by a person walking across the floor.

Professor Wayne, of Cincinnati, Appellee's witness, (Rec. p. 866 x*q* 1) also testifies that this exhibit announces the fact that fat can be decomposed by water at the common temperatures of the air; but as it appears from his answers to x*qq*. 190 to 201, (Rec. p. 868) that he supposed that some unknown degree of heat was applied to the barometer, and that steam might have been present above the oil, and that he had not the least idea as to the length of time involved, it is evident that his testimony has been given with more zeal than knowledge or discretion.

Wayne admits on cross-examination, however, that fat acid could not have existed in the *copper* boiler of Daniell. (Rec. p. 866.)

"x*Q*. 181. Will fat acids corrode metallic surfaces (copper, iron, and brass), when kept a long time in contact with them in the air?

"*Ans.* They will slowly—more rapidly, if heated.

"x*Q*. 182. If, therefore, the oil in Exhibit 9 had been converted into free fat acids, any metallic surfaces of brass, iron, or copper, which had been in contact therewith during a long time, would have been corroded, would they not?

"*Ans.* The word 'corrosion' here used, to some, would imply a rapid and destructive action upon the metals named. (I mention this in explanation of the use of the term.) Such rapid corrosion

would not take place with the fat acids. They certainly would act upon the metals corrosively, but very slowly; and that they did thus act would be shown more clearly from the color of the fat acids than from any corrosion evident upon the metallic vessel containing them.

"x*Q*. 183. Do you wish to be understood as asserting, as a chemist, that a surface of copper or brass would remain 'bright,' and 'with no signs of metallic corrosion in any part,' after remaining for several months in the air, at common temperatures, in contact with the free fat acids of castor oil?

"*Ans.* The case is a supposed one. I would say that a flat surface of copper or brass could be thus exposed for several months, coveaed with merely a film of fat acids, or as much as would remain on the surface of the metal—that in the time mentioned a solution or corrosion of the metal on its whole surface thus exposed would take place."

Wayne also explains what the mucilaginous substance was. (Rec. p. 869.

x*Q*. 198. Do you understand the "mucilaginous-looking substance" mentioned in Exhibit 9 to have been the free fat acids of castor oil?

Ans. I do not.

x*Q*. 199. What do you understand said "mucilaginous-looking substance" to have been?

Ans. It may have been albuminous matter separated from the oil, which separation will take place when castor oil and water are mixed together. Castor oil thus treated will become slowly rancid, and will increase in rancidity by time. This mucilaginous matter will separate and form a layer between the oil and water.

This well-known change of fats is explained by Dumas, Exhibit 6, Rec., p. 249.

AS TO EXPERTS' CONSTRUCTION OF APPELLANT'S SPECIFICATION.

Mr. E. S. Renwick, in his search for reasons to limit the Appellant's process to temperatures above 440°, travels out of the specification, and quotes from Appellant's original specification and his British patent.

A short explanation of the state of the art may here clear up the complication attempted to be made. The passage referred to reads:

"The second part of my said invention consists of a mode of "treating a mixture of fatty matters (whether acid or neutral) and "a carbonated alkali, for the purpose of manufacturing soap.

"For this purpose, I mix the fatty bodies, in a liquid state, "with the quantity of carbonated alkali in solution which may "be necessary to convert it into soap, and then subject the mixture "to a high temperature under pressure *in like manner as herein* "*before described* in practising my mode of obtaining fatty acids "and glycerine, and for this purpose, *the apparatus herein before* "*described* for producing the fatty acids and glycerine by a contin- "uous process, may be used for the production of soap *in a* "*similar manner.* The carbonated alkali may be dissolved merely "in the quantity of water which is intended to remain in the soap "produced. If resinous or other matters are intended to be used "in the manufacture of the soap, they may be dissolved either in "the alkaline solution or the oil, or may be combined with the soap "after it has left the apparatus.

"The degree of heat required is less than that which is neces- "sary to produce free fat acids, and should generally be kept "between the melting points of tin and bismuth. At about three "hundred and fifty degrees of Fahrenheit the neutral fats will form "soaps, with the solution of alkaline carbonates, but a higher tem- "perature will produce the result more quickly.

"The carbonic acid expelled from the alkali in this process, "when performed in the *apparatus above described*, escapes as the "soap issues from the exit valve; if but little water has been used, "and the quality of the soap is sufficiently good without further "purification, it can be put into frames to harden at once, or it may "be put into the coppers, boiled up, and separated from the glycer- "ine (when neutral fats have been used), and finished in the usual "manner."

The plain meaning of the passage referring to the degree of heat is, that when working the soap process in *the same way* as directed for the fat acid process, that is, in the *same form of apparatus*, and with the mixtures passing through it at the *same rate*, and being exposed to the heat during the *same length of time*, the complete conversion of a mixture of fat and carbonated alkali into soap and glycerine will take place at a lower temperature than would be required to effect in the *same length of time* the complete conversion of a mixture of fat and water into fat acid and glycerine.

The affinity of the alkali for the fat, and its emulsionizing tendency, helps the decomposing action of the water, and causes it to produce the decomposition, either at a lower temperature, if the same length of time is given, or in a shorter time, if the same temperature is employed, than in the case where water alone is used, and has to do all the work of decomposition, and to produce fat

acids in a free state, with its acid affinities unsatisfied. That is, *using the same length of time in both cases*, water plus carbonated alkali, will decompose fat and form soap at a lower temperature than that at which water alone will decompose fat and form free fat acids.

The next sentence recommends the practical lower limit of temperature for working "the apparatus hereinbefore described," "in like manner as hereinbefore described," when "used for the production of soap in a similar manner," at about 350° Fahr., and adds "but a higher temperature will produce the result more quickly." Mr. Renwick would have us believe that the patentee meant to assert that 350° Fahr., was the *lowest temperature* at which fat and carbonated alkali will form soap, *no matter how long a time is given*, and that as it is said, "that the heat required is less than that which is necessary to produce free fat acids," the patentee in effect declares that no fat acids will be produced except at temperatures above 350°, no matter how long a time is given.

Now, the prior state of the art and current knowledge of the subject matter is to be kept in view in construing the specifications, and we learn from Defendant's own experts, Smith and Wayne, that it has been notorious for 40 years, that at 212° Fahr., and in open vessels, fat and carbonate alkali will form soap, only they require a long time to do it completely.

PROF. SMITH, RECORD, p. 829.

x*Q*. 170. Has it been known to chemists since the time of Chevreul, that neutral fats will form soaps with alkaline carbonates (of potash and soda) by long boiling at 212° F.?

Ans. Chevreul, I believe to have been the first person to show that boiling fats and a solution of carbonate of potash would result, after a long continued action, in the formation of soap, and what is true of the carbonate of potash is equally true of the carbonate of soda. The proportions of fats and carbonate of potash employed by Chevreul were one part of fat and two of crystalized carbonate of potash.

PROF. WAYNE, RECORD, p. 870.

x*Q*. 206. Has it been generally known to chemists, and published in standard chemical treatises, prior to 1854, that solutions of alkaline carbonates would form soaps with neutral fats, by long boiling therewith at 212° F.; if so, please describe the successive stages of the operation.

Ans. It has, one portion of the carbonated alkali is decomposed, and the carbonic acid thus liberated forms a bicarbonate with another portion of the alkali, which bicarbonate is decomposed at a boiling heat, and this action and reaction continues until the end of the process.

See further on this subject the testimony of Tilghman (Record, p. 1030.)

Q. 60. In the specification of your English patent of Jan. 9, 1854, you state as to the manufacture of soap, "the degree of heat required is less than that which is necessary to produce free fat acids, and should generally be kept between the melting points of tin and bismuth." Did you intend thereby to state broadly that fat acids would not be produced at heats less than the melting point of bismuth?

Ans. I had no such intentions, having had repeated proofs to the contrary. I intended thereby only to state the temperature which the manufacturer should employ to make soap in the coil apparatus, working with the rapidity mentioned for said apparatus, to-wit, in ten minutes, in the same way that the heat for making fat acids in the same apparatus, with the same speed, was directed to be between bismuth and lead melting heats. The proof that a heat above tin melting (440° F.) was not necessary for making soap is given in my English specification of June 9th, 1854, which states that a temperature of 350° will produce soap, but that a higher temperature produces the effect more rapidly. The heat mentioned for producing fat acid was intended in the same manner as the one practically recommended as best for working the coil apparatus, and not as the temperature at which the decomposition commenced. In fact, no one, having the slightest acquaintance with chemistry could suppose that a decomposition operating so rapidly at a given degree of heat, could suddenly cease to operate at all at a temperature but little below it.

RENWICK'S INTERPRETATION OF CLAIM.

Edward S. Renwick, Appellees' expert, fixes the minimum of Tilghman's process at 440°, and not 510°, as Appellees' brief does. (E. S. Renwick, R. p. 949.)

"*Q.* 2. Are you acquainted with Letters Patent No. 11,766,

granted to Complainant, dated the 3d of October, 1854, for improvement in process for purifying fatty bodies; and, if yea, state fully the kind of apparatus in which the process is described to be carried on, and at what temperatures the fatty bodies are to be decomposed?

"*Ans.* I am acquainted with the contents of Letters Patent No. 11,766, referred to in the question, by having carefully examined a printed copy thereof" * * * * "The temperature at which the fatty bodies are to be decomposed is one at or about the melting point of lead, which is above the temperature at which fats begin to decompose by heat alone, even in open vessels. The patentee in one place states that the change or decomposition takes place with some materials, such as palm-oil, at or below the melting point of bismuth, (510° F.) It also gives the test of melting tin (440° F.) as the lowest temperature which the operator need take any note of, and the test of melted nitrate of potash (660° F.) as the highest temperature which the operator need take any note of. These tests, coupled with the absence of any statement that the process can be operated at a temperature as low as the melting point of tin, with any fat matter, show *that the temperature relied upon is one exceeding the melting point of tin*, (440° F.,) and not exceeding the melting point of nitrate of potash, (660° F.,), the temperature of the melting point of lead (612° F.,) being the temperature for general practice."

It will be recollected that in this case the Appellees *admit* in their answer that they use a temperature of over 400° F.

EFFECT OF HIGH HEAT ON FAT IN THE ABSENCE OF WATER.

Abundant proof is given in the Record that the temperatures 510 to 612° F., recommended for working the coil apparatus, not only produce no injurious effect upon fats when the air is properly excluded, but that they actually produce valuable *improvements* in the color and smell of many fats, and of the soaps subsequently made from them. Record, p. 1033. Dubrunfaut's French Patent, 1841.

"Tallow submitted to the same treatment, that is to say heated to the temperature of 617° F., (325C°), notably *loses smell*, and produces soaps which have the *smell of tallow* in a *less* degree."

Fish oils are directed to be heated up to from 608 to 626° F., to remove permanently their fishy taste and smell, and they then produce soaps which have not and do not acquire by any length of time the original odor of the oil. "If the oil is *only* heated to 572° F., it is only temporarily freed of smell, and the soap made of it,

though without smell at first, rapidly regains a strong smell of fish."

Palm oil is asserted by Appellee to be as easily injured and decomposed by heat alone at 510° F., as tallow was asserted to be at 612° F., yet the same Exhibit R.. p. 1033, says "Palm oil heated in a close vessel, under pressure of 4 or 5, atmospheres (60 to 75 lbs.), can reach a temperature of 617° F. (325° C.) It is then found free from color and smell.

The same discovery of the benefits of high heat under pressure and *without water*, had been made by Tilghman and was included in the Caveat filed by him in the Patent Office, March 31, 1854

"When I wish to produce a bleaching or deodorization of neutral fats and oils, without converting them into fat acids, I pass them under pressure through a series of pipes, as before described, kept at about the *heat of melting lead*, taking care that *no water* is present. R. A. TILGHMAN.

Wilson & Payne's Patent, R., 103, in which fats are distilled in a current of super-heated water, the heat is maintained as nearly as practicable at 600°. A charge of palm oil often requires 36 hours to work off, and consequently the last portions have *endured 36 hours* of *heat of 600°* F., entirely *without injury*, a fact proved in this case by its continued production of pure glycerine. Rec., 910. Report Juries, Paris Exhib., pp. 495–496.

Tilghman's testimony, R., 1014, agrees with Wilson's and Dubrunfaut's as to palm oil being uninjured at lead melting heat.

"I have frequently had palm oil heated in close vessels to the melting point of lead for several hours, and afterwards proved it to be entirely in the state of neutral or undecomposed fat."

The fact of the fat being *under pressure* when heated, also makes a most important difference as to the heat at which a fat is injured by heat. Dubrunfaut mentions as above, giving from 60 to 75 pounds pressure to the heated palm oil, and in the coil apparatus, the fat is subjected to a pressure of at least 2,000 pounds to the inch. Many instances are well known in chemistry of similar effects of pressure in preventing decomposition into gaseous products at heats that otherwise would effect it. Limestone, or carbonate of lime, gives off its carbonic acid at a red heat, and becomes quicklime, if, by suitable pressure, the escape of the carbonic acid is prevented the carbonate of lime simply melts, and is found on cooling to have crystalized into marble.

SELF-CONTRADICTIONS OF APPELLEES EXPERTS.

Counsel in their brief seem inclined to institute a comparison as to the scientific standing of Appellant's and Appellees' experts.

We would have no reason to fear such a test, if it were possible to lay before the Court proper materials upon which to form an opinion.

What the Court can judge of, however, is the apparent care, consistency, fairness and accuracy of these witnesses in stating facts, and in drawing conclusions.

Defendants' leading expert, Dr. Smith, comes forward with more than ordinary pretensions. His titles, and those of various stones he has examined, cover no less than four pages, (p. .) He studied under Chevreul, the founder of this art, and made a special study of his works, (p. 791).

He obtained full practical knowledge at the Paris factory of his personal friend, De Milly, of whom he is the partner and agent in the United States, (xq. p. 119, 833).

He was an expert in the former suit against Werk, three or four years previously, (p. 809, xq. 53,) and has been engaged several months in preparing his present testimony.

From a person so thoroughly acquainted with both theory and practice, with the books and the factories, we should expect nothing but the most sound and well-weighed conclusions, based upon complete and exhaustive knowledge of the chemical facts.

Dr. Smith testifies (R., p. 813 x q. 83, p. 108,) that he has discovered "that as early as 1825 fats had been decomposed by less than an equivalent of alkali, as shown at that period by the researches of Chevreul," which he quotes, page 373, par. 1051 of said book.

Now this is the main point in issue in this suit—the very pinch of the case; if this is true, the Defendants are only doing now exactly what Chevreul did and published in 1826.

Dr. Smith had the book in his hand, and repeats his assertion in answer to (xq. 86, R., p. 814.)

But when confronted with a passage in the book, but two pages further on, he is compelled to admit (xq. 88), *that Chevreul himself flatly contradicts the statement he had just attributed to him, and*

states the precise reverse to be the fact; and then Dr. Smith says, that *he differs from Chevreul in opinion,* (xq. 88), and had differed from him for twelve months, (xq. 89); that he never repeated Chevreul's experiment; that he don't say positively Chevreul is wrong, but only that he *may be wrong,* (xq. 92); that he could not say positively whether Chevreul was wrong or not, until he had tried a set of experiments, which might in the end prove Chevreul to be correct, (q. 92); and that he never heard his correctness on this point disputed by any other chemist.

His colleague, Wayne, (x*q*. 46, p. 846), also says, that Chevreul's experiments and conclusions on this point have been received by chemists as correct from 1823 to the present day.

Now either Dr. Smith never really understood Chevreul's statements, and never took the trouble of reading the article to the end —two pages on, where the conclusions are summed up, and thus in honest though most gross and inexcusable ignorance quotes Chevreul as saying exactly the opposite of what he did say; or, if he did understand Chevreul's experiment and conclusion, he is guilty of making a wilful misstatement as to the most important point in the whole case.

It cannot be doubted that the first supposition is the true one, particularly as numerous other instances of great carelessness and inaccuracy of statement can be found in his testimony.

This witness appears to be peculiarly unfortunate in his inability to quote correctly the most important parts of printed documents actually in his hands.

In the discussion as to the Perkins' scum, Exhibit, No. 1, the main question is, whether its chemical proportions there described, proved it to be free fat acids, or to be something else. Dr. Smith thought it probably was, or might be, free fat acids; Professors Booth and Rogers thought it was neutral lime soap.

Now, free fat acids are *very soluble*, or have a *marked solubility* in alcohol, while neutral lime soap is only slightly soluble in alcohol.

Dr. Smith, when asked (xq. 138, p, 823,) "*to quote all the passages containing any proof*" that the scum was free fat acids, says, "2, the substance under consideration was *very soluble* in alcohol, and again, 4, this substance could not be regarded as a neutral fat, from its *marked solubility* in cold alcohol."

Here there is an assertion of a distinct chemical test, showing that the substance could not be neutral lime soap, and probably might be free fat acids.

But when asked to show in the Exhibit, his authority for the assertion that the substance was "very soluble," or had a "marked solubility" in alcohol, he is obliged to request (xq. 140,) that the words "very" and "marked" be struck out of his answer.

This simple correction of an error in reading, destroys two or four of his reasons for supposing the scum to be free fat acids.

Two other properties of the scum are described: 1–That its hot solution in alcohol will, by cooling, let fall a precipitate. And 2–That it dissolved in alkalies, making a turbid solution. It was, of course, very important to ascertain whether or not these properties belonged also to neutral lime soap, but Dr. Smith, when asked (xq. 131, 132,) if this be so, is obliged to admit that he does not know. (Rec., p. 804.)

Dr. Smith says (xq. 30, 31, 32,) that neither he nor any other chemist can tell how much free fat acid, and how much neutral lime soap is contained in Defendants' product, while his colleague, Wayne, produces (Exhibit E, Rec,. p. 564,) two sets of analysis of it, giving the exact quantity of each substance.

The testimony of Mr. Wayne is likewise full of contradictions on the most important points.

He was a witness in the first suit against Werk, and then testified that his product was an acid lime soap (Record, p. 495, q. 35,); that in an acid lime soap there is no free fat acid (p. 497, q. 51); and that in Werk's product there was no free fat acid (recalled tests., p. 46, q. 2). Yet he afterward produces analyses of this same product, stating that it contained about 40 per cent. of free fat acid (Plff. Bill, Exh. E), which analyses he confirms and adopts in his present testimony (xq. 41).

In the former suit he testifies that to enable water alone to decompose a fat, a heat of 550° to 650° Far. is necessary. (Rec. p. 492). He now says water alone will decompose fat at heats below 320° Far. (xq. 79.) Rec. p. 851).

He says, his own experiments prove, that both the fundamental facts of Pelouzes' theory are false (xq. 75 to 79. Rec. p. 851), yet he considers this theory "plausible and correct." (q. 219. Rec. p. 871).

Dr. Rand's testimony is confined chiefly to his own theoretical opinions, such as in their nature can seldom be brought to any decisive test. He considers steam the principal active agent in decomposing fat; that it is far more active than water because it is so much expanded (xq. 21, p. 219); and following out this reasoning, he arrives at the conclusion (xq 31 to 35, p. 222) that if the Defendants, and Ropes, and Jones, would only abandon their present absurd and expensive digesters, containing water under pressure, and use simple steam at atmospheric pressure only, in open tubs, they would get the same products they do now, and in a still shorter time.

It is to be regretted, that this important discovery was not made before, and has not even been acted upon since, as it would certainly have saved all the litigation on the subject, past, present and future.

According to this expert Mr. Grant, (p.), must have had his million pounds of fat converted into fat acids by the action of steam, without ever suspecting it.

Dr. Raud, after discussing at length Pelouzes paper upon De Milly's process, q. 6, p., Rec. p. 880), and stating the precise chemical nature of the product, (xQ. 13, p. 882), admits on cross-examination (xQ. 49, p. 838), that he had entirely misunderstood De Milly's process, and had thought that all the water was evaporated by the super-heated steam, "making the process of De Milly essentially a steam process." It is only when his attention is called to it by Complainant's counsel, that he finds out that De Milly *did not use super-heated steam*, and that water heated under pressure, was an essential requisite. It is instructive to observe, that this expert's tardy discovery, that he had thus entirely misconceived the most essential conditions of the process, makes no change whatever in his opinion as to its chemical nature and results, such results never having been produced by the agents he supposed.

Appellee's expert, Wayne, shows extreme scientific accuracy in explaining the composition of Werk's product and the theory of his process, and he gives us a most alarming series of formula, (Rec. p. 497,) of the exact way in which stearic acid from its being tri-basic formed his imaginary compound "acid lime soap." Now there are such things in chemistry as tri-basic acids, but stearic acid does not happen to be one of them, and when Mr. Wayne is

cross-examined (Rec. 876, xQ. 37,) as to his authority in saying that stearic acid is tri-basic, he suddenly abandons that position, but only to take one infinitely worse. He says, "I wish to strike out the word tri-basic in said answer and insert *tri-acic* compound in lieu thereof." A tri-acic acid is a simple impossibility and is exactly same as if a witness, who for several years had been testifying to a man having three wives, should suddenly exclaim, "I have been mistaken all this while, what I really mean is that the man has *three husbands*."

x*Q.* 38. Please state whether the formula of stearic acid given at the close of that examination, are those of a tri-basic or merely three equivalents of monobasic acid, and whether you wish that statement to be retained as an expression of your views.

Ans. They are three equivalents of a monobasic acid; I do not wish that statement retained as my opinion.

That is to say that the words he wrote down (in his own hand writing, as not trusting to the Commissioner's accuracy in such abstruse matters,) really meant something entirely different from what he intended, but did not know how to express. Instead of writing down that one man had three wives, as he intended, he writes that three men had a wife each. Being unimpeded by such elementary chemical knowledge this expert is all the more fittted to give opinions as to unknown chemical compounds producing unknown decompositions inside a boiler "into which we have not intro-vision. (R. p. 542.)

NOTES AND ADDENDA.

TABLE OF PRESSURES AND TEMPERATURES.

(BOOTH, RECORD, p. 586.)

Q 22. Please give a table, from the best authorities, of the temperatures corresponding to different pressures up to 300 pounds per square inch.

Pressure in Pounds.	Degrees Fahrenheit.	Pressure in Pounds.	Degrees Fahrenheit
0	212°	165	374°
15	250°	180	380°
30	275°	195	386°
45	293°	210	392°
60	308°	225	398°
75	320°	240	403°
90	331°	255	408°
105	341°	270	413°
120	350°	285	418°
135	358°	300	422°
150	367°		

CONTINUATION FROM THE TEXT WRITERS.

Pounds.	Degrees.	Pounds.	Degrees.
315	427°	510	472°
330	431°	585	486°
345	435°	660	491°
360	439°	735	510°
435	457°		

CHEVREUL'S PATENT, (ENTIRE,) EMBRACING EXHIBITS 18 AND AA.

Certificates of inventions. Paris, vol. 41, pp. 392, 393.

January 5, 1825.

Certificate of invention for fifteen years to Messrs. Gay Lussac and Chevreul, of Paris, for the application of the stearic and margaric acids to illuminative purposes: * *

"We *saponify* the fatty bodies destined for illumination or which we will allow to remain in the state of soap, either at the ordinary temperature of ebullition with the sole pressure of the atmosphere, or at a more elevated temperature with the pressure of several atmospheres. We have found that the *saponification* executed in the latter manner, presents greater advantages over that which is commonly practiced with the sole pressure of the atmosphere.

We separate the stearic and margaric acids from the oleic acid by the following processes: (R. 87, p. 244).

"1st. We decompose by water the soapy mass obtained by saponifying grease, tallow, etc., *by an alkali;* the water dissolves the oleate to the exclusion of the great mass of the stearic and margaric acids, which are left behind in the state of supersalts (*sursels*). These last are then decomposed, as well as the oleate, by hydrochloric or any other acid.

"2d. We can also decompose the *soapy mass* at once by hydrochloric acid. We heat *the fat acids resulting from the decomposition:* 1st, by pressure, either hot or cold—the oleic acid flows out and leaves the stearic and margaric acids; 2d, by alcohol, which at low temperatures dissolves the oleic in preference to the two other acids.

"We treat the soap successively: 1st, by cold alcohol, which dissolves much oleate; 2d, by boiling alcohol which dissolves all the salts formed by the fat acids. As it cools the stearic and margaric acids are precipitated in the state of salts, and the oleic acid remains in solution. We then separate the alkali combined with these acids by means of any other acids whatever." (R. pp. 93-94).

EXHIBIT NO. 5.

ENCYCLOPEDIA RORET, PUBLISHED IN PARIS, 1849, pages 110, 111, 113, 114, and 115.

TRANSLATION.

"The milk of lime poured into the tub, along with the melted tallow, and the current of steam being continued, the temperature of the mixture rises, and the combination takes place gradually.

"To hasten it, and render it more complete, it is proper to stir the mass thoroughly. This stirring is really of great importance, for not only does it accelerate and render more complete the combination of the lime with the fat acids, but it also permits us to diminish the proportion of this base, and the quantity of sulphuric acid used to saturate it.

"'We can get an idea,' says M. Dumas, 'of the saving which would result from an improved saponification, in the single item of sulphuric acid.'

"In reality, the tallow employed containing only 88 per cent. of fat acids, we find, by calculation, that 100 kilos. of this tallow would require $9\frac{37}{100}$ kilos. of lime to saponify it. But in most factories they employ more than 15 kilos. There is then, for every 100 kilos. of tallow, at least 6 kilos. of lime, which it is necessary to saturate in *pure waste*, by 10 or 11 kilos. of sulphuric acid at 66°. We insist, then, on this point, and repeat that a powerful stirring would enable us to diminish this loss.

After all, the manufacturers alone can judge of this question, and decide whether, in their position, the cost of establishing and maintaining the motive power necessary for this prolonged stirring is greater than the loss they undergo by the saturation of the *excess* of lime. At all events, it is evident that the process of saponification by lime, as now generally practised, is not sufficiently economical, and that it would be desirable to seek some other method, by means of which the quantity of caustic alkali used to saponify the fatty matter could *be reduced more nearly to the proportion indicated by theory*..

* * * * o o *

Another useful observation is presented, viz: That the saponification of fats by lime can scarcely be executed, rapidly and completely, except under a pressure greater than that of the atmosphere. It was believed for a long time that saponificalion by lime could only be effected in closed boilers, and, although it has since been ascertained that increased pressure, and consequently increased temperature, are not indispensable for this saponification; it is quite possible that in returning to the former opinion, we may effect an important diminution in the proportion of time required for a given weight of fat.

This idea, however, is not novel; for it was announced in the patent of Gay Lussac & Chevreul, and has been repeatedly taken up by manufacturers, AND WE DO NOT KNOW WHY IT HAS BEEN ABANDONED,

We will quote, for example, the process of saponifying fats patented by Milly & Motard, in 1834, and described in Vol. LII, page 505, of the "Brevets d'Invention," from which the following is extracted: "The boiler employed by the inventors is of a cylindrical form, its upper part terminating in a man-hole, heremetically closed by a bolted cover. This cover has in its centre a stuffing-box, through which passes a stirring rod, with a cross piece of wood on its lower end. Another hole in the cover is for a tube, which plunges some six inches into the boiler, and which is to contain a thermometer.

"The boiler is heated by a furnace of usual construction.

"Water is first run into the boiler, equal to about twice the weight of fat to be saponified; the fat is then introduced, and when it is melted, milk of lime, sufficient for the saponification of the fat is run over the liquid mass.

"The boiler is then closed, and the liquid stirred at short intervals, by raising and lowering the stirring-rod or plunger.

"This operation is continued until the thermometer marks 277° Fahr., (136° Centigrade.) As the whole mass becomes stiff after a certain time, agitation is no longer practicable: the operation is left to itself, and ceases with the diminution of the temperature, When the thermometer only shows 212° Fahr., the boiler is opened, and emptied by the man-hole as soon as it is sufficiently cooled."

TILGHMAN'S ENGLISH PATENT, PROVISIONAL SPECIFICATION—EXHIBIT Q.

"Provisional Specification left by the said Richard Albert Tilghman at the Office of the Commissioner of Patents, with his Petition, on the 9th January, 1854.

"The first part of my invention consists in a *new method* of obtaining free fat acids and solution of glycerine from animal and vegetable fatty and oily bodies which have glycerine as their base. Two processes are now practiced for this purpose, one called the saponification process, making use first of lime to decompose the fat, (forming a line soap,) and then of some strong acid to neutralize and remove the lime, leaving the fat acids in a free state.

"In the other process the fat is heated with concentrated sulphuric acid, which so acts upon or combines with the glycerine of the fat, that boiling with water removes both of them, leaving the fat acids in a free state.

"Now, my invention consists in exposing the aforesaid fats and oils to the action of water *at a high temperature and pressure*, the *effect of which* is to cause the combination of the water with the elements of the neutral fats, so as to produce at the same time free fat acids and solution of glycerine. Those fats, which, like palm-oil, are highly colored, are also to some extent bleached by the process, and the strong smelling oils are more or less deodorized. The operation is performed in a *continuous* manner by pumping an intimate mixture of the fat and water through a very strong metallic vessel heated to the requisite degree. From it the mixture (now changed into free fat acids and solution of glycerine) escapes through a safety-valve so heavily loaded as not to open by the mere pressure of the steam. The solution of glycerine settles from the hot fat acids, and may be purified as usual. The fat acids may be used for making soap and candles at once, or bleached by any of the ordinary methods, or may be distilled with hot steam in the usual manner.

"The second part of my invention relates to the manufacture of soap."

SUIT BROUGHT BY MOINIER AND ITS RESULTS.

"[Imperial stamp.]

"According to summons of Marecat, (Charles,) bailiff ('huissier') of civil tribunal of first instance of the Department of the Seine, sitting in Paris, and residing 'Boulevard de Sebastopol, No. 46.'

"The Plaintiff summoned the Defendant to appear on Thursday next, 17th November, at the court-room, and before the tribunal, in order that—

"Whereas, by *verbal agreements*, in the date of the 13th of September, 1858, Mr. Fountaine Moreau, acting for and in behalf and for the account of Mr. Tilghman, declared that this latter was the owner of patents of, &c., &c. * * * * * *

Said agreement was *in writing* and copy in full given. (R. p. 325.)

"Now, therefore, considering that no opposition is made to the claims of the Plaintiffs, and that the same have been satisfactorily proven; for these reasons, rendering judgment in the first instance, declares null and void the agreements in question, and condemns the Defendant by all legal means, and even by bodily constraint, according to the laws of April 17, 1832, and December 13, 1848,

to pay to the Plaintiffs 2,000 francs, to which sum they have, for the present declared their claim for indemnity to be reduced." (Record 87, p. 300).

Tilghman, having heard of this, appealed.

And the results are—

"The following has been determined upon:

"ARTICLE 1ST. By these presents the parties annul all treaty and agreements existing in any form between them, and especially the contract of September 13, 1858.

"ARTICLE 2D. The law-suit existing between the parties, and from which *Mr. Fontaine Moreau has made appeal*, shall no longer continue, and shall cease.

"ARTICLE 3D. Messrs. Moinier & Co., and Messrs. Charles Leroy & Durand, shall pay to Mr. Fontaine Moreau the sum of five hundred francs each, or together, the sum of one thousand francs, as compromise of said law suit.

"ARTICLE 4TH. Each of the parties shall pay its own expenses with reference to said suit.

"ARTICLE 5TH. Mr. Richard Albert Tilghman shall re-enter into the free use and enjoyment of his patents.

"In consequence, all engagements taken are null and of no effect, both those effecting said Mr. Tilghman, as those affecting Messrs. Moinier & Co., and Messes. Charles Leroy and Durand, the parties meaning by means of this compromise to renounce all claim whatever, and on any ground whatever." (Record, p. 325).

EXHIBIT DUBRUNFAUT'S FRENCH PATENT. RECORD, p. 1032.

Additional extracts from Dubrunfaut's patent, Deps. S. and N., No. 4.

Patent of fifteen years, dated Aug. 28th, 1841, to Pierre Dubrunfaut, of Paris, for processes and apparatus which have for their object the purification of various animal and vegetable fats, and particularly the oils from fish, grain and of palm, etc.

The principle of these operations is founded on the action of heat on the various fatty bodies at a temperature at which they begin to decompose, and during which they undergo distillation, to a greater or less degree, either in the air or in a vacuum. Thus whale oil, for example, heated, in an open vessel, up to 248° F. (120° C.), undergoes the motions of boiling; which is only caused by the escape of water. If we continue to heat it up to from

608° F. (320° C.) to 620° F. (330° C.), a lively boiling is produced, and the oil undergoes a commencement of decomposition which gives rise, among other products, to a carburetted hydrogen gas, and to a matter which powerfully irritates the throat and eyes. If we then stop the heating and cool down the oil, we find that it has lost completely its characteristic fishy taste and smell. The oil in this state is more dense, more viscid and more colored than the original oil: it is less congealable, it burns nearly as well and it produces, with greater ease, soaps which have not, and do not acquire by any length of time, the original odor of the oil.

If we heat the oil to a lower temperature than that above indibated, as, for example, only to 572° F. (300° C.), it decidedly lessens its smell, retains a taste of dried fish and is not thoroughly disinfected; for the soap made of it, though without smell at first, rapidly regains a strong smell of fish. * * *

The oil thus heated in an open vessel undergoes an action from the air, which colors it more or less powerfully, and, in certain cases, this may be injurious. I avoid this injury by heating the oil in a close vessel, in an atmosphere free from oxygen; for example, in an atmosphere of carbonic acid, or—still better—by heating it in a vacuum. * * *

Tallow submitted to the same treatment, that is to say, heated to the temperature of 617° F. (325° C.), notably loses smell, and produces soaps which have the smell of tallow to a less degree. Palm oil, heated up to 428° F. (250° C.), begins to boil, and furnishes solid fat acids by the distillation, among which margaric acid predominates. By continuing the distillation until the oil is reduced to four-fifths of its volume, it is found to be deprived of its original color and smell, so as to be able to produce solid soaps, entirely without smell, and white. In this distillation the oil ought not to produce any fat acids but those pre-existing in the oil; that is to say, that in all these cases we should stop the operation when the boiling point rises above 617° F. (325° C.).

* * * * * * *

Green fats and bone grease are purified like tallow, and do not need any peculiar treatment. * * *

March 4th, 1842. Patent for additions and improvements.

Palm oil, which is known to be a natural mixture of fatty acids and neutral fats, is deprived of its color and smell by a distillation which carries off from it a fifth or a sixth of its volume of solid fat acid; then the boiling-point rises to 620° F. (330° C.), and, if we wish to continue the distillation, the heat will rise rapidly as high as 752° F., and we will then have, at the same time, all the products which result from the alteration of fatty bodies, acroleine, and carburetted hydrogen. * * *

Palm oil heated in a close vessel under a pressure of 4 or 5 atmospheres, can reach a temperature of 617° F. (325 C.). It is then found to be freed from color and smell. * * *

Fish oil can be freed from smell by a current of steam, but it is impossible to obtain a satisfactory result if the oil is not heated at least to 536° F. (280° C.). It is necessary, moreover, in this case to continue the process for at least twelve hours. By passing the steam through it at a higher heat, less time is needed for disinfection.

It is to be remembered that in this process the oil becomes more colored than by rapid disinfection at 626° F. (330°C.); it also acquires a very strong bitter taste. We must remark also, that in this process the steam only carries off that small portion of fat acids which is found developed in the oil, about 2 or 3 per cent.

In fact, it is only when the oil has been heated to from 617° F. (325° C.), to 626° F. (330° C.), that it can produce these fatty acids in abundance, and with ease by the action of a current of steam at a heat below the boiling-point of the oil.

STEAM DISTILLATION.

Note to pages 28,–40, and 58 to 65.

This subject is exhaustively discussed by Mr. Tilghman in his supplemental evidence.

RECORD, p. 1022.

x*Q.* 26. Can fat be decomposed into fat acids and glycerine by the action of steam alone?

Ans. It can.

x*Q.* 27. When did you first have knowledge of such fact?

Ans. I first knew of the decomposition of fat into fat acids and glycerine by distilling them in a current of steam from the announcement of the patent of Wilson and Payne, dated July 24, 1854, which is Complainant's Exhibit 1624, Record 87, p. 87.

x*Q.* 28. You are now aware, are you not, that Professor Scharling had published this fact to the world as early as 1850? See Defendants' Exhibit No. 12, Werk suit.

Ans. I am not aware that he did so, I saw Scharling's paper in the year 1852, and made a great many experiments upon the subject at the time.

x*Q.* 29. Scharling says: "My invention was excited in the highest degree when I learned that in England they employed superheated steam for the formation of the free acids of palm-oil, and that at the same time the products were thereby bleached. In an experiment in the laboratory, two pounds of fresh palm-oil were put into a small copper boiler and superheated steam passed therethrough for two hours. There was obtained one pound of the fat acids, which was nearly colorless, and whose melting point was nearly 54° C. * * * After it was thus determined that various glycerines, though with unequal facility, might be decomposed simply by superheated steam, in like manner as by strong bases, I proceeded to try the operation of superheated steam upon whale oil, dolphin oil, was," etc. This was published to the world by Scharling in 1850, and I ask you whether it does not contain the announcement that fats can be decomposed into fat acids by the action of superheated steam?

Ans. This paper certainly shows that Scharling supposed he had decomposed neutral fats into fat acids by distillation in a current of steam. It equally shows that Scharling was entirely ignorant of facts at that time well known to both chemists and manufacturers, which, if known to him, would have destroyed all the foundations upon which he based his assertion.

x*Q.* 30. Your expert witness, Professor Booth, (Ans. to xQ. 287, Werk case,) when interrogated as to Scharling's paper, says: "* * * I infer from knowledge subsequently gained, that the heat employed must have decomposed a portion of the fat into free fat acids and glycerine." Do you coincide with Professor Booth in such opinion?

Ans. I do not. From knowledge of the fact, probably unknown to Professor Booth, that the principal results mentioned by Scharling had been obtained years before, in England, by the parties whose process Scharling had evidently heard of, but imperfectly, and from which he drew an entirely false infernce. In Record, 87, page 86, Complainant's Exhibit 10,191, is the patent of Gwynne and Gorgee Ferguson Wilson, of 1844.

In this patent the process attempted by Scharling is there described, but in a more thorough and complete manner than was attempted by Scharling. They describe the distillation of crude palm-oil in a current of super-heated steam. Like Scharling, they stop the distillation when only one-half had been distilled over, but Scharling, by his silence as to the oil remaining in the still, would lead the reader to suppose that the same process could be continued until all the palm oil had been converted into fat acid. These manufacturers, however, could not afford to neglect so large a portion of their material, and they give directions for its further treatment, to put it in such state that it could be distilled, having found that it was not further distillable in the first operation. The simple explanation of this course is given by the fact that palm oil contains already formed free fat acids in its commercial state, and that free fat acids are easily distillable in a current of super-heated steam, while neutral fats are not. The large quantities of free fat acids existing in palm oil, are mentioned in Exhibit 11, Record 87, page 238, where palm oil containing free fat acids equal to 50 per cent. of its weight is mentioned.

If the decomposition of a neutral fat could have been effected by Scharling, it was only at the end of his experiment that he was in condition to prove it; but when he arrived at that point, he simply abandons the residue in his still (which was now neutral palm oil, free from pre-existing fat acids), as if it were not worth further attention. The manufacturers, however, take this neutral palm oil out of the still, and, by means of lime saponification, convert it into fatty acids, a product they were unable to obtain by further continuance of the steam distillation. Even the half which has distilled over in this process, however, is not pure fat acid, as Scharling has supposed; but it is still a mixture of free fat acid with so much neutral fat in it as to render it useless for the manufacturers, and they accordingly direct this product to be distilled a second time, when they at last get an acid fit for the manufacture of candles. The residue in the still of this second distillation is treated by them as a neutral fat, which they convert into fat acids by the lime-saponification process to fit it for distillation.

x*Q*. 31. In your answer to the last question, you compare the process described in Scharling's paper with the patent of Gwynne

& Wilson of 1844, No. 10,191, and state, as I understand you, that the two are substantially the same; am I correct in this?

Ans. The two processes I believe to be substantially the same, with the exception that temperature mentioned in Scharling's experiment, being entirely inadequate to produce the results he describes, I have concluded it to be a clerical error in the original account in Erdmann's Journal.

x*Q.* 32. What was the temperature employed in the patent of Gwynne and Wilson referred to?

Ans. The temperature employed is not stated in the patent of Gwynne and Wilson, but from the facts stated of the results therein produced, those familiar with such processes know that a temperature of about 550 to over 660° Fahrenheit is usually employed to produce them in practice.

x*Q.* 33. You have heretofore stated that your first knowledge of the fact that fats can be decomposed into fat acids and glycerine by the action of steam alone, was derived from Wilson and Payne's English Patent of 1854. State wherein that patent differs from the patent of Gwynne and Wilson of 1844.

Ans. It differs from said patent in the announcement of the fact that fat acids and glycerine could both be obtained in the process of distilling fats in a current of steam, and in giving the temperature most suitable for producing this previously unknown result. The apparatus employed in the process identical with that used in the patent of 1844, and the temperatures employed were practically the same, but it was first made known in the patent of 1854 that glycerine was produced in the process previously described in 1844.

x*Q.* 34. You think, then, that glycerine was obtained in the process conducted under the patent of 1844. Is this so?

Ans. I do not think glycerine was produced by the manufacturer under the patent of 1844, but I have no doubt that it was frequently produced, but that its production was in such small quantity, and it was diluted with such an enormous proportion of water, that its presence was never known or even suspected by the manufacturers, and it consequently was run to waste.

x*Q.* 35. Having stated that the apparatus in the two patents of 1844 and 1854 were the same, and that the subject-matter under treatment was the same, but stating in effect that the results obtained were different, state why such was the fact.

Ans. The two patents differed in the results sought after. The patent of 1844 was to obtain the fat acids pre-existing in a free state in the palm oil of commerce. When these fat acids had distilled over, the patentees of 1844 withdrew the 50 per cent. residue in the still, as a material not suitable for further distillation in a current of steam, as the distillation of fatty matter became exceed-

ingly slow, and its quality for candle making purposes very inferior. They did not know that this slow distillation of imperfectly decomposed fat was then accompanied with the production of a small proportion of free glycerine. The patentees of 1854, having discovered the presence of free glycerine in these last mentioned products, had an inducement to carry on the process to all the residue of the charge which the patentees of 1844 had not.

x*Q* 36. To return to Scharling; he mentions, does he not, that the palm oil distilled by him was fresh?

Ans. He does, but as the palm oil is not produced in Germany, but is obtained only from the interior of Africa, it was impossible that he could obtain really fresh palm oil. I have never heard of, or examined any palm oil that did not contain considerable proportion of fresh fat acids, and the patentees of 1844 show that the average distillable proportion (that is, pre-existing free fat acids), by their process, was about one-half in ordinary commercial palm oil. Defendant's Exhibit, No. 11, Record 87, mentions a palm oil containing 80 per cent. of free fat acids.

x*Q*. 37. Quote the paragraph from the patent of 1844, if any there is, which states that the palm oil under treatment contained about one-half free fat acids prior to its treatment.

Ans. No statement is made of the exact percentage of free fat acid in the palm oil operated upon, but the fact is communicated in the statement, that they have found it preferable "to distil over only about one-half of the palm oil under process in the first distillation." The direction is also given to convert the residuum in the still "into fatty acids, by means similar to those used in the manufacture of stearic acid or by other suitable means, and to distil the fatty acids so obtained." These two paragraphs show distinctly that free fatty acids alone were considered suitable for distillation by the Patentees, and that when one-half the palm oil has been distilled over, they found it necessary to treat the residue in the still as other neutral fats are treated to convert them into free fat acids. The fact that the fatty bodies in their neutral or neutral state are unfitted for distillation in a current of steam, is stated by the same Patentee in a previous patent of a few months earlier date (Compl'ts Exhibit, 10,000 Gwynne and Wilson patent of Dec. 25, 1843,) in these words: "In the course of a series of experiments in which we have been engaged for some time past, relative to the distillation of fatty and oily matters, we have particularly observed that fats and oil in their natural state are not well adapted for distillation, owing as it appears, to the presence of the ingredient called "glycerine," and that, although fats and oils can be distilled in their natural state, and the distillation itself destroys or decomposes the "glycerine," it is a preferable mode of operation to abstract, destroy, or decompose the "glycerine" in the first instance,

and afterwards to submit the fatty or oily matters to distillation in the acidified or modified state produced by such action." Their subsequent patent of 1844, is carried on in exact accordance with the statements just made from the patent of 1843, and the chief novelty of the patent of 1844 is given in these words: "Now we have discovered that the products obtained by the distillation in an atmosphere of a suitable gaseous body of palm oil in its crude state as imported, can be applied to the manufacture of candles, without treating such products with nitric or nitrous acid," etc.

x*Q.* 38. Scharling speaks in his said paper of having decomposed castor oil, tallow and other fatty matters, besides palm oil, by the action of steam. Do you think, as to these other fatty bodies, that they were partially decomposed before subjected by him to this process?

Ans. As Scharling gives no account of any tests employed by him to ascertain the purity of the fat acids which he says he obtained, there seems to be no reason for trusting the results he asserts from these other bodies more than the experiments on palm oil. We know nothing of the previous history of these "other fatty matters" on which he operated, (to enable us to form an opinion) as to their neutral condition. A chemist who makes such gross mistakes as Scharling has done in this paper as to palm oil would be but little trusted by chemists as to any other experiments he might make. He quotes the finding of Brodie's cerotic acid in the products of the distillation of wax in a current of steam, as a proof that he had decomposed that substance also, whereas it is notorious to chemists that Brodie found large percentages of free cerotic acid existing in many samples of natural wax. From direct repetition of Scharling's experiments on tallow, made by me in the year 1850, I can testify to the valueless quality of the products of the distillation for the manufacture of candles. I found that the product contained so large a proportion of neutral fat that it was practically less valuable than before the operation.

x*Q.* 39. Did you, in 1850, or at any time prior to 1854, decompose fat, producing free fat acids and glycerine, by the action of steam?

Ans. I have no doubt that I did so, but did not know what result I had been thus obtaining until seeing Wilson and Payne's patent in 1854.

x*Q.* 40. When and where did you do this first?

Ans. In 1850, in Philadelphia, I first distilled fatty matters in a current of steam, at a temperature so low as not to produce acroleine. I know now by the light of subsequent discoveries what results were produced in those experiments, though unknown to me at the time from the small degree in which they were produced, which concealed their existence, and made the result entirely value-

less. I have no doubt the same results were produced in the distilling process described by Chevreul and Gay Lussac in their patent many years previous. Said result equally escaped their notice.

x*Q.* 41. From your present knowledge on the subject, state what results you produced by this steam process in 1850.

Ans. From present knowledge, I believe I obtained a mixture of fat acids with so much neutral fat as to render them practically valueless, and that there must have been glycerine in minute quantity in the large amount of condensed water.

x*Q.* 42. Where were these operations of 1850 performed by you?

Ans. In my laboratory, at Philadelphia; I had also done the same thing repeatedly on a large scale, about the same time, in the factory of Grant, Crumpton & Company, Philadelphia, upon quantities of over 1,000 pounds at a time. It was, in fact, by their failures to realize the results expected from reading Scharling's paper that Mr. C. H. Grant first requested me to make such experiments. I was shown a complete distilling apparatus which had been fitted up by the firm for the express purpose of practising; as a manufacturing process, the methods prescribed by Scharling, but their results were so entirely contradictory to their expectations, that Mr. C. H. Grant came to me with a translation of Scharling's paper to see if I could show them the cause of their failure.

x*Q.* 43. Then, prior to your experiments, you had read Scharling's paper, Is this so?

Ans. It is.

x*Q.* 44. And it was the reading of this paper, under the request of Mr. Grant, which induced you to make such experiments. Is this so?

Ans. It is.

x*Q.* 45. Did you not represent to Mr. Grant that such experiments were highly successful?

Ans. I did not; on the contrary, I represented to him that they were a perfect failure, and that I believe that Scharling was a humbug, and was not acquainted with the matter on which he wrote, but knowing that palm oil was worked by a distillation process on a very large scale in England, by Price's Patent Candle Company, I examined a long series of patents which had been out by Mr. G. F. Wilson and others interested in that company. I then soon found that Scharling had been misled by an erroneous report of the process used in distilling palm oil in England, and had made statements from his imperfect knowledge, and still more imperfect experiments, that he would not have made if he had seen the original patents, or experimented a little further, as any reliable chemist would have done before publishing results.

x*Q.* 46. At the establishment of Grant, Crumpton & Co., did you undertake the distillation of neutral fat by superheated steam?

Ans. I did not undertake the distillation of neutral fats by superheated steam as a desirable process for manufacturing fat acids, but I was frequently obliged to work this process upon large residues of neutral fat left in their still in consequence of imperfect decomposition which had been effected by the previous action of sulphuric acid on the fat. When such imperfectly decomposed fats are distilled, the free fat acids pass over rapidly and at a moderate heat, carrying some portion of neutral fat along with them, but the mass in the still soon becomes entirely a neutral fat, and then has generally been worked over by simple distillation with steam to the great injury of the manufacture.

x*Q.* 47. Did you not at their establishment attempt the distillation of neutral fats by steam, which fats had not previously been subjected to any other treatment?

Ans. I do not remember ever having attempted a single experiment of that kind at their factory, and as I had made many experiments on such a distillation of neutral fats in my laboratory, with uniformly bad results, I had no inducement to attempt it on a large scale.

x*Q.* 49. Has not the distillation of neutral fats by steam, and their decomposition into fat acids and glycerine, been conducted for many years at the establishment of Price & Co., in England, under the patent of Wilson & Payne of 1854?

Ans. I believe that process was worked for a short time, being the interval between their discovery of the decomposition and their getting at work the apparatus for carrying out my patent. I have every reason to believe that the process of decomposing neutral fat by distillation with steam, was not adopted by them or any other manufacturer permanently as a means of decomposing fats on a large scale. I know that said process has been tried repeatedly by many manufacturers, and I have heard of no one who has adopted it. G. F. Wilson published an account of the working of this process at their factory prior to their obtaining a license to use my process of decomposing fats by water at a high temperature and pressure, but I have seen no statement as to the extent of their using their process on a large scale subsequent to the working of my process at their factory, which was still kept in operation there at the date of my last communication with them, being July 13, 1865, (see Complainant's Exhibit Wilson, Record 340, page 353). I know that after my apparatus had been running at their works for a few months, when some part of it got out of order, so as to stop the supply of glycerine, the greatest excitement was produced among the superintendents of the works as to the means of keeping up the supply of glycerine to their customers, and they resort-

ed to most energetic means of repairing said apparatus, without regard to expense, in order to place it again in working order. As they had at their command the largest collection in the world, of distilling apparatus for fatty bodies, and did not wish to apply it to the production of glycerine and fat acids by their own process, I infer that they found the water process preferable for that purpose; as I know of no manufacturer in the world using said distilling process for neutral fats, I believe it to be entirely valueless as a manufacturing process, and only interesting as a chemical curiosity.

See, also, his re-direct examination.

RECORD, p. 1029.

Q. 59. State whether the decomposition of neutral fats into fat acids and glycerine by distillation in a current of steam has been generally adopted as a manufacturing process, and, if not, why not, in your opinion?

Ans. It has not been adopted generally, nor have I heard of a single factory in the world which has adopted it as a regular working process. I have seen many manufacturers who have tried the process, and their results all agreed with my own, which were that the distillation took place so slowly that if even the products had been those of a perfect decomposition, it would not have paid to carry it on. But the fact was, the products, instead of being useful, were entirely useless for the candle manufacturer, owing to the large proportion of neutral fat contained in them, which made them unfit for pressing, and to yield a soft, greasy product. The process might have been usefully employed for the manufacture of pure glycerine if my own process had not shortly before supplied a cheaper means of producing both pure glycerine and perfectly decomposed fat acids at the same time. It was, in fact, only a means of producing pure glycerine, that the steam distillation process was, for a few months, partially worked by Price's Patent Candle Co. I obtained a sample of the fat acids produced by them in such working, and found it to contain a large proportion of neutral fat, but their glycerine was very good. I have reason to believe that such production of glycerine on a large scale was abandoned by them as soon as they got the apparatus for working my process in practical operation.

PRESSURE OF STEAM.

NOTE TO PAGE 27.

x*Q.* 24. There is another requirement in the patent as to the other form of vessel ("any convenient vessel"), to wit: "the vessel must be closed and of great strength, so that the requisite amount of pressure may be applied to prevent the conversion of the water into steam," is there not?

Ans. There is a requirement that the vessel shall be strong enough to prevent the conversion of the water into steam, which was meant to realize the common and well known condition required in all other digesters; that the mass of the water should not be allowed to pass off in the form of steam, as it inevitably would if the containing vessel were not sufficiently strong to resist the pressure at the heat employed. It was never intended to prevent the formation of any steam which would naturally be produced in the upper portion of the vessel.

ANALYTICAL INDEX.

PAGE.

Statement of the case, ... 1
Abstract of pleadings, ... 2 to 5
Bill of complaint, ... 2
Answer, ... 2 to 4
Classification of references as to novelty, . . 4 to 5
Appellant's *Points*, ... 6 to 8E

ARGUMENT FOR APPELLANT.

Statement of Appellant's invention, ... 9 to 12
State of the art, ... 9
Appellee's invention was a "new manufacture" or process, ... 9
Based on a discovery he had made, ... 9
Appellant's specification announces discovery, and describes necessary apparatus for carrying out his "process" based thereon, detailing the description of the form he *prefers* to use, . . . 9
Existing condition of apparatus used in the art to which Appellant's patent relates, ... 10
Apparatus known in the art, consisting of *closed boilers*, with *safety valves*, *agitators*, and *liquid circulators*, ... 10 to 11
Authorities to show that known machines need not be described, ... 11 to 12
General instructions applicable to all apparatus, and particular instructions for continuous apparatus, ... 12
Tilghman's information before making his application, 13 to 14
Use of simple digesters, ... 13 to 14
Successful use of pressure as low as 120 lbs, . . 14

PAGE.

Continuous apparatus preferred by Tilghman, . . 16 to 17
Tilghman's reason for recommending it, . . . 16
His present views of it, ... 16 to 17
Safer than boiler form, ... 17

Introduction of process into use, ... 17 to 24
Patented in England, January 9, 1854, . . . 17
Public use in England in 1854, see Wilson's lecture. 17
Graham's, Hale's, and Meyer's letters, . . . 72 to 73
Tilghman's testimony, ... 81
Use in boiler form 1857, ... 18
Use in America, ... 20 to 24
Appellees' use, ... 20 to 24

Infringement, ... 24 to 45
Analysis of Appellant's patent, ... 24 to 25
Extract from answer describing apparatus and process of Appellees, ... 25 to 26
Necessity of "constant intermingling" set forth in patent, ... 26
Use of lower temperature and longer time than that recommended by Tilghman as *most efficient* contemplated in patent, ... 27
Pressure of *steam underpressnre* contemplated in patent, ... 27
Steam present in experiments of inventor during development of his invention, ... 27
Appellees admit *steam* not to be an *essential* in their process, ... 27 to 28
Steam under pressure has no decomposing effect . 28
Steam distillation a mere *chemical curiosity*, . . 28 to 29
Lime to the extent of Appellees use recommended in the patent, ... 29 to 34
Tilghman experimented with *lime* before his application, ... 29 to 30
Its use in large quantity, an economical mistake, . 30
Werk's use of *lime* (4 to 6, per cent.) simply a combination of the old lime saponification process with Tilghman's process. . . . . 30 to 35

PAGE

Werk's product in a mechanical mixture of neutral *lime soap* and fat acid, ... 32

Appellees use of alkali no greater than that recommended in the patent, ... 33

Chemical action the same with or without *lime*, . 33 to 35

Lime merely masters the action of the water by aiding to form an emulsion, ... 34

Lime, the equivalent of; mixing and agitating devices, ... 34 to 35

Similarity of Appellee's process and that of Wright and Fouché, ... 35

Wright and Fouché's process an infringement on Tilghman's, ... 36 to 39

Use of lower *heat* than that preferred by Tilghman does not take it outside of the patent; chemical action the same, ... 38 to 39

Water the only active efficient agent of Appellee's process, ... 39 to 45

Appellees admit that in the absence of *steam* their product would be the same, ... 39 to 40

Steam alone will produce no effect upon the fat, . . 40

Steam therefore *not* the *efficient agent* 40

Lime soap heated with neutral fat produces no free fat acid, ... 40

Lime soap, therefore, *not* the *active efficient agent*, . . 40

Water heated with fat at 320° F. produces *free fat acids and glycerine*, ... 40

Water, therefore, *is* the *active, efficient agent*, . . 40

Unfairness of experiments made by Appellee's witnesses as to the power of water at 320° F., . . . 41–43

Increased quickness of time from the use of *lime*, simply the consequence of the formation of an *emulsion*, . 44

Use of *lime* produces same result as intimate *mechanical mixture*, ... 44

Economical value of *lime questionable*, ... 45

Decisions of legal questions as to the scope of Tilghman's patent, its validity and infringement, . . . 45–52

ARGUMENT FOR APPELLANT IN REPLY.

PAGE.

* * * * * * * * * * *

Statement of the Art

Natural fat explained, ... 53 to 54

"*Rendering*" of natural fats, ... 53 to 54

Braconnot (1816) announces natural fat not to be a single fat, but composed of three different fats, stearine, margarine and olein, having different fusing points, ... 54

Chevreul.

Chevreul (1825) announces that each fat is a salt, and composed of an acid and a base. Hence he obtained three acids, stearic, margaric and oleic, and a common base—glycerine, ... 54

He obtained them by first making soap and then decomposing it, ... 54 to 55

Hence the term saponification, ... 55

Super heated water under pressure not the decomposing agent in his patent, ... 55 to 56

Expert testimony as to Chevreul's patent . . 55 to 56

Decomposition by *sulphuric acid* distillation, . . 56 to 57

Made fat acid, but destroyed glycerine, . . 56

Did not use highly heated water under pressure, . 56 to 57

It was a process by distribntion, ... 56 to 57

Sulphuric acid distillation process and lime saponification process the only methods for obtaining fat acids at the date of Tilghman's invention, . . . 57

Attempted decomposition by *steam*, ... 58 to 66

History of, ... 58 to 66

Scharling's attempt (1850) unsuccessful, . . 58 to 60

Gwynne and Wilson (1843), ... 60

Dubrunfaut (1841), ... 60 to 61

Difference between distillation by steam and decomposition by super-heated water, . . . 61 to 62

Jury report of Exposition at Paris (1855), . . 62 to 64

Wilson carried out steam distillation process July 24, 1854, after seeing Mr. Tilghman's process, . . 64

PAGE.

Steam distillation, even after Wilson's discovery, *impracticable* and *abandoned;* a mere *chemical curiosity*, ... 64 to 66

PROOF OF NOVELTY OF APPELLANT'S INVENTION.

Tilghman was the first to announce it *even as a scientific fact*, that highly heated *water* under *pressure* will decompose neutral fats into fat acid and glycerine. Admitted by appellee's witnesses:

Mitchell, ... 66
F. Verdin, ... 66 to 67
J. T. Verdin, ... 67
Van der Weyde, ... 68
Smith, ... 68
Wayne, ... 68
Grant, ... 69

Testimony of Appellant's witnesses:

Booth, ... 69, 71 and 72
Rogers, ... 70
Genth, ... 70
Bridges, ... 70 to 71
Appellee's Exhibit 19, Record p. 259, ... 72
Gibbs. 72

Acknowledgment of Tilghman as discoverer of hot water process made prior to or outside of all litigation.

Wilson's lecture, ... 72 to 73
Exhibit Graham, ... 72
Exhibit Hale, ... 73
Exhibit Meyer, ... 74
Patent Office letter, ... 74
Jury Report, London Exhibition, (1851.) . . . 75
Report of Paris Exhibition, (1855.) 75
London Exhibition, (1862.) . . . . . 75 to 76
Muspratt's Chemistry, ... 77
Watt's Dictionary of Chemistry, ... 78

Practicability of Tilghman's process in both forms of apparatus.

Booth, ... 79

PAGE.

Wilson's lecture, ... 80
Tilghman, ... 81
Exhibit Graham, ... 82
Exhibit Hale, ... 82
Exhibit Meyer, ... 82
Booth's test of coil apparatus, ... 83 to 84
Rogers, ... 84
Booth's test of quality of product 85
See also Verdin, ... 86 to 87

MANNER IN WHICH APPELLEES TRIED TILGHMAN'S COIL.

Verdin, ... 87 to 89
Intentionally mismanaged, ... 89
Thomas, ... 89
Appellant offered to show coil apparatus practically at work to Mitchell and it was declined, . . . 90 to 92

MONIER'S EVIDENCE, ... 92 to 101
He testifies that fats cannot be decomposed by superheated water, ... 92 to 93
Is contradicted by Appellees own witnesses, . 93
And by Graham, Hale & Meyer, ... 93 to 94
Real reason of Monier's failure, ... 94 to 97
Contradicted by his own actions and letters, . 98 to 101
See also, ... 143 to 144
Safety and Commercial practicability of Tilghman's Coil Apparatus, ... 101 to 105
Absolute safety of coil apparatus demonstrated, . 101 to 104
Enormous manufacturing capacity of coil apparatus 104 to 105
What Tilghman intended to patent, . . . 105 to 108
False interpretation of patent, deduced from the inferred extent of patentee's knowledge, set right, 105
Attorney's letter, ... 105
What Tilghman claims, ... 106 to 108

PERKINS' SCUM, ... 108 to 121
Does not pretend to describe any process for making fat acids and glycerine. 108

PAGE.

The exhibits not only do not assert the *scum* to be fat acids, but they furnish chemical proof that it was not fat acids, ... 109 to 111

Appellee's experts do not testify that the *scum* contained fat acid, but merely infer that it *might* do so, ... 111 to 112

Appellant's experts testify *positively* that the *scum* was not fat acid, ... 112 to 115

Scum was really lime soap, ... 114 to 119

No information as to the production of fat acids imparted to chemists by the exhibits, . 119 to 121

Appert's process, ... 121

Maniclere's process, ... 121 to 124

Did not produce, nor intend to produce fat acids; it was a rendering process, . . . , 121 to 124

Daniell's Barometer, ... 124 to 128

What it was, ... 125

Describes no process for obtaining fat acids or glycerine, ... 125 to 128

Says nothing about glycerine, and does not assert that acids to be present, ... 124 to 127

Wayne admits fat acids were probably not present, 127 to 128

Appellee's expert's construction of Appellant's patent, . 128 to 131

Where he is in error, ... 129 to 130

Real construction, ... 130 to 131

Appellee's expert, Renwick, construes claim as covering temperatures between 440° F. and 660° F., . 131 to 132

Effect of high heat on fat in the absence of water, 132 to 133

Self contradictions of Appellee's experts, . . 134 to 138

Table of pressures and temperatures, ... 139

Chevreul's patent, ... 140

Exhibit No. 5 (Encyclopædia Roret), . . . 140 to 142

Tilghman's English Patent Provisional Specification, 142 to 143

Suit brought by Monier, and its result, . . 143 to 144

Dubrunfaut's Patent, ... 144 to 145

Extracts from Tilghman's testimony.